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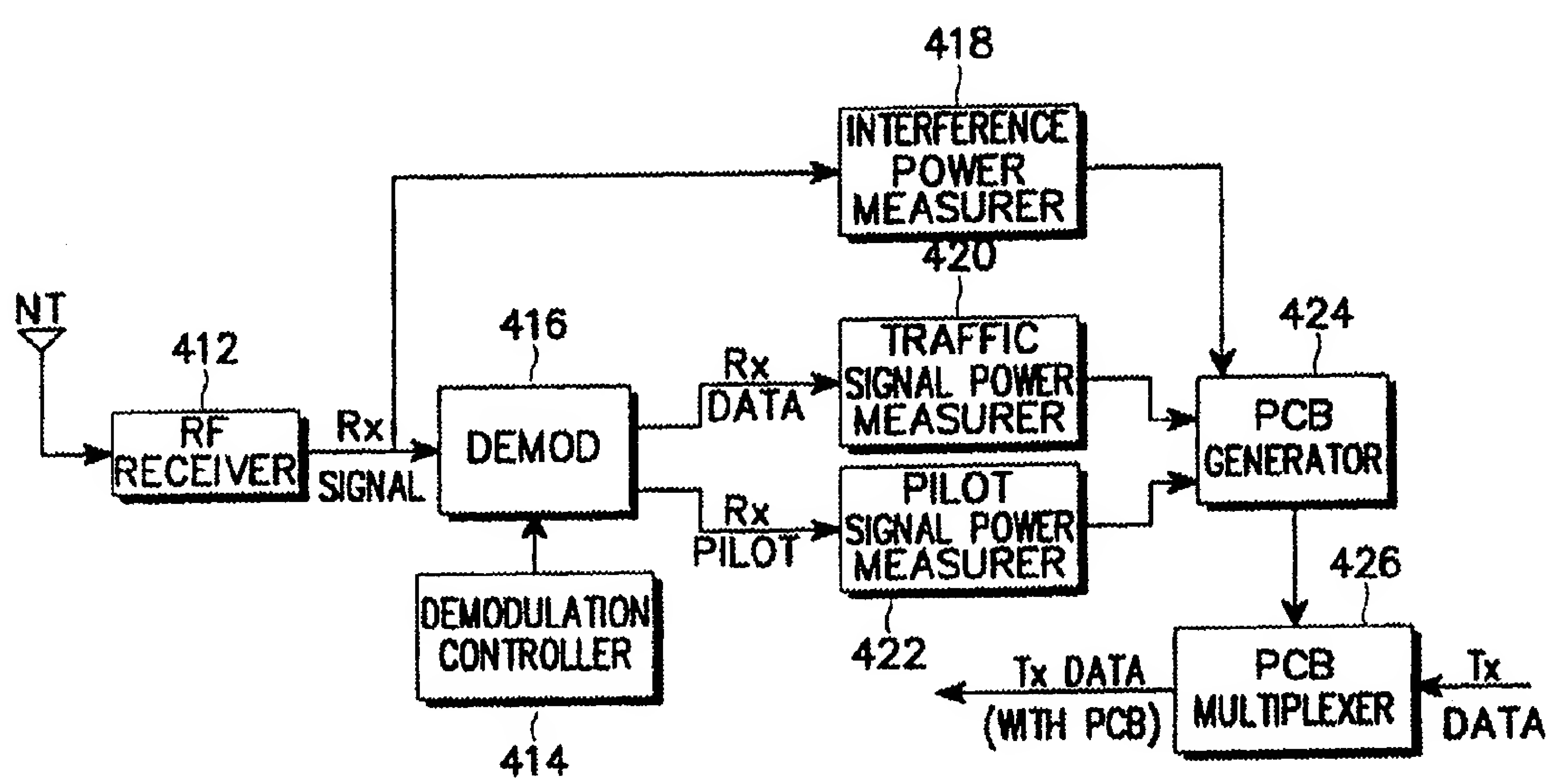

(57) Abstract

A power control device for a mobile station in a CDMA communication system including a base station which transmits a traffic signal via one of at least two antennas and transmits a common channel signal via another antenna. The device comprises a receiver for receiving the transmitted traffic and common channel signals via one antenna; an interference power measurer for measuring power of an interference signal output from the receiver; a common channel power measurer for measuring power of the common channel signal output from the receiver; a traffic channel power measurer for measuring power of the traffic signal output from the receiver; a power control bit generator fo generating a power control bit for a traffic–OFF channel which has transmitted the common channel signal by operating the power of the pilot and interference signals; and a multiplexer for multiplexing the power control bit to a reverse link channel.

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POWER CONTROL DEVICE AND METHOD FOR MOBILE COMMUNICATION SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a power control device and method for a mobile communication system, and in particular, to a power control device and method capable of controlling transmission power even when a traffic channel is switched OFF.

2. Description of the Related Art

To perform power control in a mobile communication system, a receiving party measures the strength of a received signal, which varies according to the existing condition of a radio link, and sends the result from the measurement to a transmitting party. The transmitting party then increases or decreases the power of a transmission signal in accordance with a power control command from the receiving party. To control the transmission power of a base station in such a mobile communication system, a mobile station measures a signal-to-interference ratio (SIR), compares it with a threshold to generate a power control bit (PCB) and provides the base station with the generated power control bit through a reverse channel. Upon receipt of the power control bit, the base station controls the power of a transmission signal by a specific step according to the value of the received power control bit. That is, for forward link power control in a mobile

communication system, the mobile station measures the power of a signal transmitted from the base station and provides the base station with the result from the measurement. The base station then controls the power of a transmission signal according to the power control information from the mobile station. This method is referred to as closed loop power control.

With reference to FIG. 1, there is illustrated a forward link power control procedure in a mobile communication system. Referring to FIG. 1, when a base station (BS) transmits a signal (111), a mobile station (MS) receives the signal with a propagation delay (113). Upon receipt of the signal, the mobile station measures the strength of the received signal and thereafter, sends a power control bit according to the measured result (115). The base station then receives the power control bit with a propagation delay (117) and controls the power of a transmission signal according to the received power control bit (119). As illustrated in FIG. 1, power control is performed in units specified as power control groups (PCGs), and actual power control is performed with a delay of at least one power control group.

As described above, closed loop power control is performed according to power control group units. The base station sends a signal to the mobile station, and the mobile station then measures an SIR of the signal received from the base station, compares it with a threshold and sends the base station a power control bit generated according to the comparison result. The base station then analyzes the power control bit and controls the transmission power on the forward link for a next power control group according to the analysis. This power control method can be applied in the case where a traffic channel is continuously transmitted via a single antenna. In this method, power control for the traffic channel is performed based on the measured power of a signal on the traffic channel.

However, for a specific channel structure where a traffic channel is switched ON/OFF, signal transmission is discontinuous. Such ON/OFF switching may occur, for example, in the case where a base station has multiple antennas to support a forward transmission diversity, or for performing a handoff, or to support a discontinuous transmission (DTX) function. In this case, the closed loop power control method described above cannot be used.

Accordingly, when the traffic channel is switched ON/OFF in a state where a call is setup between the base station and the mobile station, it is required to virtually control the transmission power of a traffic channel even while the traffic channel is switched OFF to immediately initiate power control when the communication is restarted (i.e., when the traffic channel is switched ON).

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide a device and method for controlling transmission power by transmitting a specific command channel signal via a traffic-OFF channel in a mobile communication system.

It is another object of the present invention to provide a device and method for separately controlling transmission power of a traffic-ON antenna and a traffic-OFF antenna in a CDMA mobile communication system supporting transmission diversity.

It is a further object of the present invention to provide a device and method for measuring, at a mobile station, the power of specific common channel signals received from a base station during a handoff to control the power in a mobile

communication system.

It is a still further object of the present invention to provide a device and method for measuring, at a receiving party, the power of a specific common channel signal received from a transmission party for a non-transmission duration in a discontinuous transmission mode to control transmission power of the transmission party in a mobile communication system.

In accordance with one aspect of the present invention, there is provided a transmission device for a CDMA base station which includes at least two antennas and a switch for switching a spread traffic signal to one of the antennas. The transmission device comprises an adder connected between the switch and a traffic-OFF antenna which does not transmit the spread traffic signal, for transmitting a specific common channel signal via the traffic-OFF antenna.

In accordance with another aspect of the present invention, there is provided a power control device for a mobile station in a CDMA communication system including a base station which transmits a traffic signal via one of at least two antennas and transmits a specific common channel signal via another antenna. The device comprises a receiver for receiving the transmitted traffic and common channel signals via one antenna; an interference power measurer for measuring power of an interference signal output from the receiver; a common channel power measurer for measuring power of the specific common channel signal output from the receiver; a traffic channel power measurer for measuring power of the traffic signal output from the receiver; a power control bit generator for generating a power control bit for a traffic-OFF channel which has transmitted the specific common channel signal by operating the power of the pilot and interference signals; and a

multiplexer for multiplexing the power control bit to a reverse link channel.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings in which:

FIG. 1 is a diagram illustrating a general power control method in a mobile communication system in accordance with the prior art;

FIG. 2 is a diagram illustrating a power control method in a mobile communication system according to an embodiment of the present invention;

FIG. 3 is a block diagram illustrating a base station in a mobile communication system, which supports virtual power control according to an embodiment of the present invention;

FIG. 4 is a block diagram illustrating a mobile station in a mobile communication system, which supports virtual power control according to an embodiment of the present invention;

FIG. 5 is a detailed block diagram illustrating a baseband demodulator, an interference power measurer, a traffic power measurer and a pilot power measurer in the mobile station of FIG. 4;

FIG. 6 is a detailed block diagram illustrating a PCB generator in the mobile station of FIG. 4;

FIG. 7 is a flow chart illustrating a virtual power control procedure in a mobile station according to a first embodiment of the present invention;

FIG. 8 is a flow chart illustrating a virtual power control procedure in a base station according to the first embodiment of the present invention;

FIG. 9 is a flow chart illustrating an actual power control procedure for a

traffic channel in mobile station according to the first embodiment of the present invention;

FIG. 10 is a flow chart illustrating an actual power control procedure for a traffic channel in a base station according to the first embodiment of the present invention;

FIG. 11 is a diagram illustrating characteristic curves for virtual power and pilot power of an antenna, a traffic channel for which is switched OFF;

FIG. 12 is a flow chart illustrating a virtual power control procedure in a mobile station according to a second embodiment of the present invention;

FIG. 13 is a flow chart illustrating a virtual power control procedure in a base station according to the second embodiment of the present invention;

FIG. 14 is a flow chart illustrating a virtual power control procedure in a mobile station according to a third embodiment of the present invention; and

FIG. 15 is a flow chart illustrating a virtual power control procedure in a base station according to the third embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the present invention will be described hereinbelow with reference to the accompanying drawings.

(1) Transmission Diversity

The transmission diversity is used when a base station wirelessly transmits a forward link to a mobile station; the base station transmits traffic signals via at least two antennas. The mobile station then separately measures strengths of different pilot signals transmitted by periods from the antennas of the base station, generates an antenna select signal based on the measurement and sends the select signal to the base station. The base station then transmits transmission signals by

alternating the antennas according to the select signal. In another method, the base station may transmits the traffic signals by alternating the antennas according to a predetermined alternation pattern.

For this transmission diversity, a new power control method is required which can separately control power of signals transmitted alternately from two or more antennas. In particular, it is required to control power of an antenna, a traffic channel for which is switched OFF.

(2) Handoff

A handoff occurs when a mobile station terminates communication with a base station presently in service and initiates communication with a new base station. During the handoff, the mobile station first receives a traffic signal from the base station in service and then receives a traffic signal from the new base station beginning at a certain time. In order to control power of the traffic signals transmitted from two or more base stations, switching between the base stations, it is necessary to control transmission power of the base stations, traffic channels for which are being switched ON/OFF.

(3) Discontinuous Transmission

For the discontinuous transmission, there are provided a transmission duration and a non-transmission duration for a traffic channel signal according to whether there is data to be transmitted. In this case, there is required a power control method for the non-transmission duration.

To perform power control of a traffic channel in a mobile communication system according to an embodiment of the present invention, a common channel,

i.e., a perch or pilot channel must be established. The common channel is transmitted with fixed power for respective antennas designated for each cell sector, so that it is possible to calculate a reference value for transmission power. The respective channels have the same transmission power but use different codes in a code division multiple access (CDMA) communication system. That is, the channels use different PN (Pseudo Noise) sequences or different orthogonal codes (Walsh codes can be used for the orthogonal codes). To increase the number of codes, it is possible to use Walsh codes with extended length.

A method for transmitting a specific common channel signal to a traffic-OFF channel and for virtually controlling transmission power of the traffic-OFF using this signal, for forward transmission diversity, will be described by way of example. It is important to note, however, that the virtual power control method can be applied in the case of a handoff or a discontinuous transmission.

With reference to FIG. 2, there is illustrated a forward power control method for a mobile communication system supporting forward transmission diversity. FIG. 2 shows a case where a base station uses two transmission antennas. In FIG. 2, power gains of the antennas are independently set so that power of the two antennas may be separately controlled. In FIG. 2, a bold line represents a time duration where traffic is transmitted, and a fine line represents a time duration where the traffic is not transmitted and only the pilot signal is transmitted. In the example, it is assumed that an antenna switching duration is multiple times a unit power control group duration.

In addition, it will be assumed herein that a channel for transmitting a signal on a specific common channel during a non-transmission duration is a traffic

channel, and the specific common channel is a pilot channel.

Referring to FIG. 2, a base station first transmits to a mobile station a traffic channel signal via an antenna ANT1 for a time which is a multiple of the unit power control group (PCG) time and upon expiration of the time, switches to another antenna ANT2 to transmit the traffic channel signal (212). The decision to switch between the two antennas can be based on the antenna receiving the higher strength pilot signal, or alternatively according to a periodic pattern.

The mobile station then receives the traffic channel signal from the antenna ANT1 for one power control group duration, averages the measured power values of the received traffic channel signal, averages the measured interference power values of the received signal, compares an SIR value determined by a ratio of the mean traffic channel signal power to the mean interference power with a threshold and generates a power control bit PCB1 according to the comparison result (214). For the same power control group duration, the mobile station receives a common channel signal (i.e., a pilot channel signal) from the antenna ANT2 and averages the measured power values of the received common channel signal. Subsequently, the mobile station calculates a virtual power value from a variation between a mean power value of the presently received common channel signal (from antenna ANT2) and a mean power value of the previously received common channel signal from (antenna ANT2), and an accumulated power control command value. Using the calculated virtual power value, the mobile station averages the measured interference power values, calculates a virtual SIR value from the ratio of the virtual power value to the interference power value, compares the virtual SIR value with a threshold and generates a power control bit PCB2 according to the comparison result. The virtual power value can be calculated by adding the variation in the pilot

power value and the accumulated power control command value to the measured power value of the last received signal from the corresponding antenna (i.e., ANT2).

Thereafter, the mobile station sends the power control bits PCB1 and PCB2 generated by calculating the power of the signals received from the two antennas ANT1 and ANT2 to the base station via the reverse link (216). The base station receives the power control bits PCB1 and PCB2 with respect to the antennas ANT1 and ANT2 (218), and increases or decreases a power gain of the first antennas ANT1 and a traffic signal power or pilot signal power of the second antenna ANT 2 for the next power control group duration according to the power control bits PCB1 and PCB2, respectively (220). For the antenna ANT1 through which the traffic channel is actually transmitted (i.e., traffic-ON antenna), the power controlled gain is applied to the transmission of the traffic channel; whereas for the antenna ANT2, through which the traffic channel is not being currently transmitted (i.e., traffic-OFF antenna), the power gain is updated.

With reference FIG. 3, there is illustrated a base station transmission device supporting transmission diversity according to an embodiment of the present invention. Referring to FIG. 3, a baseband modulator 311 channel codes and spreads transmission data. The baseband modulator 311 may include orthogonal modulator and a PN spreader. A switch controller 313 generates a control signal for a switch 315 which performs the transmission diversity function. The switch 315, under the control of the switch controller 313, switches the transmission signal output from the baseband modulator 311 to a first antenna ANT1 and a second antenna ANT2. A PCB extractor 317 extracts power control bits (PCBs) from data received via a reverse link channel, which may be a reverse link pilot channel .

A gain controller 319 analyzes the power control bits and generates gain control signals G1 and G2 for controlling channel gains of traffic and common pilot channel signals being transmitted, based on the analysis. A multiplier 321 multiplies a signal output from the switch 315 to the first antenna ANT1 by the gain control signal G1 to control a gain of the transmission signal outputted to the first antenna ANT1. A multiplier 323 multiplies a signal outputted from the switch 315 to the second antenna ANT2 by the gain control signal G2 to control a gain of the transmission signal outputted to the second antenna ANT2. An adder 325 adds a first pilot signal to a transmission signal outputted from the multiplier 32. An adder 327 adds a second pilot signal to a transmission signal outputted from the multiplier 323. Here, the first and second pilot channel signals may be different from each other. An RF (Radio Frequency) transmitter 329 up-converts a signal output from the adder 325 to an RF signal and outputs it via the first antenna ANT1. An RF transmitter 331 up-converts a signal outputted from the adder 327 to an RF signal and outputs it via the second antenna ANT2. The signals output via the first and second antennas ANT1 and ANT2 assume the form represented by reference numeral 212 of FIG. 2.

In operation, a transmission signal modulated by the baseband modulator 311 is switched by the switch 315 to the first antenna ANT1 or the second antenna ANT2. The transmission signals output to the respective antennas are multiplied by the gains determined by the gain controller 319. The gain controller 319 determines gains for the transmission signals output to the respective antennas by analyzing the power control bits received via the reverse link pilot channel.

With reference to FIG. 4, there is illustrated a mobile station receiver for a mobile communication system supporting transmission diversity.

Referring to FIG. 4, an RF receiver 412 down-converts a signal received from an antenna ANT to a baseband signal. A demodulation controller 414 controls despreading and decoding operations for the received signal. A baseband demodulator 416 despreads and decodes the received signal under the control of the demodulation controller 414. The baseband demodulator 416 may comprise a PN despreader and an orthogonal demodulator.

An interference power measurer 418 measures interference power included in the received signal outputted from the RF receiver 412. A traffic signal power measurer 420 measures the power of the received traffic signal output from the baseband demodulator 416. A pilot signal power measurer 422 measures the power of the received pilot signal outputted from the baseband demodulator 416. A PCB generator 424 analyzes the respective signals output from the measurers 418, 420 and 422, and generates power control bits for the forward link according to the analysis. A PCB multiplexer 426 multiplexes the power control bits output from the PCB generator 424 to the reverse link pilot channel.

In operation, the mobile station measures the traffic power for the traffic-ON antenna and the pilot power for the traffic-OFF antenna and generates power control bits according to the measured power values and multiplexes the generated power control bits to the reverse link pilot channel. The baseband demodulator 416, under the control of the demodulation controller 414, demodulates a traffic signal from a traffic-ON antenna and a pilot signal from a traffic-OFF antenna to output traffic data and a pilot signal. For example, when a traffic signal is transmitted from the first antenna ANT1 and a traffic signal is not transmitted from the second antenna ANT2, the baseband modulator 416 demodulates the traffic signal from the first antenna ANT1 and the pilot signal from the second antenna ANT2. On the contrary,

when a traffic signal is transmitted from the second antenna ANT2 and a traffic signal is not transmitted from the first antenna ANT1, the baseband modulator 416 demodulates the traffic signal from the second antenna ANT2 and the pilot signal from the first antenna ANT1.

The demodulated traffic data and pilot signal are provided to the traffic signal power measurer 420 and the pilot signal power measurer 422, respectively, and the measured power values outputted from the power measurers 420 and 422 are used in generating the power control bits. In addition, the measured interference power value output from the interference power measurer 418 is also used in generating the power control bits. The mobile station generates the power control bits with respect to the respective antennas based on the measured traffic power value and the virtual power value measured using the pilot signal, and multiplexes the generated power control bits on the reverse link back to the base station.

With reference to FIG. 5, there is illustrated a detailed block diagram of the baseband demodulator 416 and the power measurers 418, 420 and 422 of FIG. 4.

First, a description will be provided regarding the structure of the baseband demodulator 416. Referring to FIG. 5, a multiplier 511 multiplies a received signal output from the RF receiver 412 by a PN sequence to PN despread the received signal. A multiplier 513 multiplies the PN despread signal output from the multiplier 511 by an orthogonal code for the traffic channel, to output (or extract) a traffic channel signal. A multiplier 515 multiplies the PN despread signal output from the multiplier 511 by an orthogonal code for a first pilot channel, to output a first pilot channel signal. A multiplier 517 multiplies the PN despread signal output from the multiplier 511 by an orthogonal code for a second pilot channel, to output

a second pilot channel signal from the PN despread signal. That is, the multipliers 515 and 517 separate the pilot channel signals output from the respective antennas of the base station having the transmission diversity function.

Both switches 519 and 520 select one of the outputs from the multipliers 515 and 517 under the control of the demodulation controller 414. The demodulation controller 414 enables the switch 519 to select a pilot channel signal from a traffic-OFF antenna and enables the switch 520 to select a pilot channel signal from a traffic-ON antenna. That is, the demodulation controller 414 enables the switches 519 and 520 to select the pilot signals from the different antennas. The modulation controller 414 shares switching information with the switch controller 313 in the base station transmitter by signaling or scheduling.

A channel estimator 521 estimates the strength of the selected pilot channel signal output from the switch 520. A data demodulator 523 demodulates the received data on the traffic channel output from the multiplier 513 using an output of the channel estimator 521, to output traffic data. The pilot signal power measurer 422 measures power of the selected pilot signal outputted from the switch 519 (i.e., a pilot signal transmitted from a traffic-OFF antenna).

The interference power measurer 418 measures the interference power of the received signal. The measurer 418 includes an accumulator 531 and a squarer 533, to accumulate and squares the received signal output from the RF receiver 412. The traffic signal power measurer 420 is composed of an accumulator 541 and a squarer 543, and accumulates and squares in a symbol unit the traffic channel signal outputted from the baseband demodulator 416 to measure signal power of the traffic channel. The pilot signal power measurer 422 is composed of an accumulator 551

and a squarer 553, and accumulates and squares in a symbol unit the pilot signals output from the baseband demodulator 416 to measure the signal power of the pilot channels.

With reference to FIG. 6, there is illustrated a detailed block diagram of the PCB generator 424 of FIG. 4. The PCB generator 424 includes a first PCB generator for generating a power control bit for a traffic -ON Channel and a second PCB generator for generating a power control bit for a traffic-OFF specific common channel (i.e., pilot channel). A subtracter 642 subtracts the interference power output from the interference power measurer 418 from the traffic power output from the traffic signal power measurer 420. A comparator 644 compares an output of the subtracter 642 with a threshold and generates a power control bit for a traffic-ON channel in the base station. The above configuration shows the structure of the first PCB generator.

A memory 630 includes buffers 632, 634 and 636. The buffer 632 stores a power control command value dp1 which is generated at the previous power control group during traffic-OFF state. The buffer 634 stores a virtual traffic power value which is updated after being initialized to the last measured actual traffic power. The buffer 636 stores a last pilot power lpp1 which is measured pilot power at the previous power control group. A subtracter 612 subtracts the last pilot power lpp1 of the buffer 636 from the pilot power output from the pilot signal power measurer 422. An adder 614 adds the virtual traffic power value output from the buffer 634 to an output of the subtracter 612. An adder 616 adds the power control command value dp1 from the buffer 632 to an output of the adder 614. A subtracter 618 subtracts the interference power of the interference power measurer 418 from an output of the adder 616. A comparator 620 compares an output of the adder 618

with a second threshold Th 2 and based on the comparison result, generates a power control bit for virtually controlling power of the traffic channel in traffic-OFF state. In the traffic-OFF state, the antenna outputs only the pilot signal, suppressing the traffic channel signal. The above configuration shows the structure of the second PCB generator.

In addition, during traffic-OFF, the buffers 632, 634 and 636 in the memory 630 updates the values stored therein. To this end, a delay 624 delays the pilot power and stores the delayed pilot power in the buffer 636 as the last pilot power lpp1. A delay 626 delays an output of the adder 614 and stores the delayed value in the buffer 634 as virtual traffic power. A delay 622 delays an output of the comparator 620 and stores the delayed value in the buffer 632 as the power control command value dp1.

The mobile station having the structure of FIGs. 4 to 6, generates and transmits the power control bits to a base station by separately analyzing the signals received from the traffic-ON antenna and the traffic-OFF antenna. The base station then analyzes the power control bits transmitted from the mobile station and controls the gains of the antennas independently according to the analysis. Here, for the traffic-ON antenna, the gain is applied to an actual transmission. However, for the traffic-OFF antenna, the gain is not applied to an actual transmission but is instead only maintained and updated until the traffic channel is switched ON. That is, the base station initiates a transmission power control operation using the updated gain as the traffic channel is switched ON. Further, when the traffic channel is switched OFF, the gain which was actually applied to transmission is not applied to actual transmission but instead, is only maintained and updated.

The base station performs an independent power control operation for each antenna. Further, the operation performed depends upon the current switching state. That is, when the first antenna ANT1 is actually experiencing power control, the base station does not perform actual power control for the second antenna ANT2, and simply continues updating the power gain. When the second antenna ANT2 is actually experiencing power control, the base station does not perform actual power control for the first antenna ANT1 and simply continues updating the power gain.

For traffic transmission from the base station, the switch 315, as shown in FIG. 3, is controlled according to a control signal from the switch controller 313 to switch the traffic data to the antennas ANT1 and ANT2. The demodulation controller 414 in the mobile station of FIG. 4 commands the baseband demodulator 416 to demodulate the traffic signal and the pilot signal from the corresponding antennas in the same pattern as in the switch controller 313. The switch controller 313 shares switching information with the demodulation controller 414 by signaling or scheduling.

A. First Embodiment

In FIG. 7, a flowchart associated with the virtual power control procedure in a mobile station is illustrated according to a first embodiment of the present invention. During traffic-OFF, a mobile station stores in the buffer 634 of the memory 630 the last measured actual traffic power received from the traffic channel as the virtual traffic power, the pilot power measured at the previous power control group as the last pilot power lpp1, and a power control command value at the previous power control group as the power control command value dp1, at step 711. Thereafter, the mobile station determines whether a new power control group is

initiated, at step 713. When the new power control group is initiated, the mobile station measures the power of a pilot signal from a traffic-OFF antenna, and stores, in order, the pilot power from the traffic-OFF antenna as a current first pilot power pp1, (virtual traffic power)+dp1+(pp1-lpp1) as the virtual traffic power, (virtual traffic power)-(interference power) as a virtual SIR, and pilot power pp 1 as the last pilot power lpp1, at step 715. The virtual SIR can be measured as illustrated in FIG. 6. In the present and subsequent embodiments, the power calculation formula is based on a dB value.

Thereafter, the mobile station compares the virtual SIR with a first threshold Th1 to determine dp1, at step 717. When the virtual SIR > Th1, dp1 is determined as -1 (Step 719). Otherwise, when the virtual SIR is less than or equal to Th1, dp1 is determined as +1 (Step 721). Thereafter, the mobile station sends the determined dp1 value as a power control bit (PCB) to the base station, at step 723. After sending the power control bit to the base station, the mobile station determines whether the traffic channel is switched ON (Step 725). When the traffic channel is switched ON, the mobile station ends the routine. Otherwise, the mobile station returns to step 713 and repeats the above procedure.

FIG. 8 is a flowchart associated with the virtual power control procedure in a base station, according to a first embodiment of the present invention. In the traffic-OFF state, the base station determines a gain value, gain1, of the traffic-OFF antenna for the last actual traffic gain, at step 812. Thereafter, upon reception of the power control bit (i.e., the dp1 value) from the mobile station, at step 814, the base station updates the gain, (gain1), of a traffic-OFF transmitter to gain1+dp1, step 816. Upon detection of a new power control group, at step 818, the base station determines whether the traffic channel is switched ON, at step 820. When the traffic

channel is switched ON, the base station ends the routine. Otherwise, the mobile station returns to step 814 and repeats the above procedure.

As described with reference to the flowcharts of FIGs. 7 and 8, a virtual power control procedure at an antenna of a traffic-OFF transmitter can be defined with reference to Table 1 below.

TABLE 1

```
virtual traffic power = lastly measured actual traffic power , <Step 711 >
last pilot power 1 = previously measured pilot power < Step 711 >
dp1 = previous power control command value < Step 711 >
duration traffic-OFF, the following is repeated at every power control
group
{
measure pilot power for the traffic-OFF antenna < Step 715 >
pilot power 1 = pilot power for te traffic-OFF antenna < Step 715 >
virtual traffic power = virtual traffic power + dp1
                        + (pilot power 1 - last pilot power 1) < Step 715 >
virtual SIR = virtual traffic power - interference power < Step 715 >
last pilot power 1 = pilot power 1 < Step 715 >
if (virtual SIR > threshold 1) < Step 717 >
dp1 = -1 < Step 719 >
else
dp1 = +1 < Step 721 >
transmit PCB (dp1 value) from mobile station to base station < Step 723
>
(at base station) virtual traffic power = virtual traffic power + dp1< Step
816 >
}
```

Therefore, the virtual SIR = (initial virtual traffic power value) + (accumulated power control command value) + (variation in pilot power) - (interference power), wherein the accumulated power control command value is the sum of the power control command values (i.e., dp1 values transmitted through PCB) from a traffic-OFF time to the last power control group.

With reference to FIG. 11, there are illustrated characteristic curves for the virtual power and the pilot power at a traffic-OFF antenna. In FIG. 11, a fine line represents the characteristic curve for the pilot power and a bold line represents the characteristic curve for the virtual power.

With reference to FIG. 9, there is illustrated an actual power control procedure in a mobile station according to the first embodiment of the present invention. With reference to FIG. 10, there is illustrated an actual power control procedure in a base station according to the first embodiment of the present invention.

Referring to FIG. 9, during traffic-ON, a mobile station sets actual traffic power for the lastly measured virtual traffic power, at step 911. Thereafter, the mobile station determines whether a new power control group is initiated, at step 913. When the new power control group is initiated, the mobile station measures actual traffic power, at step 915, based on

actual SIR = (actual traffic power) - (interference power)

Thereafter, the mobile station compares the actual SIR with a second threshold Th2 to determine dp2, at step 917. When the actual SIR > Th2, a second

power control bit dp2 is determined as -1, at step 919. Otherwise, when the actual SIR is less than or equal to Th2, the second power control bit dp2 is determined as +1, at step 921. Thereafter, the mobile station sends the determined second power control bit dp2 value as a power control bit (PCB) to the base station, at step 923. After sending the power control bit to the base station, the mobile station determines whether the traffic channel is switched OFF, at step 925. When the traffic channel is switched OFF, the mobile station ends the routine. Otherwise, when the traffic-ON state is maintained, the mobile station returns to step 913 and repeats the above procedure.

Referring to FIG. 10, in the traffic-ON state, the base station sets a gain value, gain2, of the traffic-ON antenna to a last virtual traffic gain, at step 1012. Thereafter, upon reception of the power control bit (or dp2) from the mobile station, at step 1014, the base station updates a gain, gain2, of a traffic-ON transmitter to gain2+dp2, at step 1016. Upon detection of a new power control group, at step 1018, the base station sends the traffic channel with the power controlled gain, gain2, at step 1020, and determines whether the traffic channel is switched OFF, at step 1022. When the traffic channel is switched OFF, the base station ends the routine. Otherwise, when the traffic-ON state is maintained, the mobile station returns to step 1014 and repeats the above procedure.

As described with reference to the flowcharts of FIGs. 9 and 10, an actual power control procedure at a traffic-ON antenna can be defined with reference to Table 2:

TABLE 2

```
actual traffic power = last measured virtual traffic power < Step 911 >
duration traffic-ON, the following is repeated at every power control
group
{
measure actual traffic power < Step 915 >
actual SIR = actual traffic power - interference power < Step 915 >
if (actual SIR > threshold 2) < Step 917 >
dp2 = -1 < Step 919 >
else
dp2 = +1 < Step 921 >
transmit PCB (dp1 value) from mobile station to base station < Step 923 >
(at base station) actual traffic power = actual traffic power + dp2 <Step
1016 >
}
```

B. Second Embodiment

With reference to FIGs. 12 and 13, there is illustrated a virtual power control procedure in a mobile station and base station, respectively, according to a second embodiment of the present invention.

Referring to FIG. 12, during traffic-OFF, a mobile station stores the last measured actual traffic power as the virtual traffic power, the pilot power measured at the previous power control group as the last pilot power lpp1, and a power control command value at the previous power control group as the power control command value dp1, and sets an accumulated power control command value sum1 to zero, at

step 1212. Thereafter, the mobile station determines whether a new power control group is initiated, at step 1214. When the new power control group is initiated, the mobile station measures power of a pilot signal received from a traffic-OFF antenna, and sets the pilot power from the traffic-OFF antenna as a current pilot power pp1, (virtual traffic power)+dp1+(pp1-lpp1) as the virtual traffic power, (virtual traffic power)-(interference power) as a virtual SIR, and the current pilot power pp1 as the last pilot power lpp1, at step 1216.

Thereafter, the mobile station compares the virtual SIR with a first threshold Th1 to determine dp1, at step 1218. When the virtual SIR > Th1, dp1 is determined as -1, at step 1220. Otherwise, when the virtual SIR is less than or equal to Th1, dp1 is determined as +1, at step 1222. Thereafter, sum1 is updated by adding the determined dp1 to sum1, at step 1224. Then the mobile station determines whether the traffic channel is ready to be switched ON (i.e., a traffic-ON ready state; Step 1226). Upon failure to detect the traffic-ON ready state, the mobile station returns to step 1214 to repeat the above procedure. However, upon detection of the traffic-ON ready state, the mobile station sends the sum1 value to the base station, at step 1228, and then, ends the routine.

Referring to FIG. 13, in the traffic-OFF state, the base station sets the last actual traffic gain as a gain value, gain1, of the traffic-OFF antenna (Step 1311). Thereafter, the base station determines whether the traffic channel is ready to be switched ON (Step 1313). When the traffic-OFF state is maintained, the mobile station maintains the gain value gain 1 determined in step 1311. However, upon detection of the traffic-ON ready state, the base station receives the sum1 value transmitted from the mobile station (Step 1315), and updates the gain value, gain1, by adding the sum1 value to the gain1 value determined in step 1311 to control the

gain of the antenna in the traffic-ON ready state (Step 1317). Thereafter, the base station determines whether the traffic channel is switched ON (Step 1319). Upon detection of the traffic-ON state, the base station controls power of a signal transmitted to the mobile station via the traffic channel using the gain control value gain 1.

To briefly summarize the second embodiment, the virtual power control method according to the second embodiment of FIGs. 12 and 13, does not transmit a power control bit for the traffic-OFF channel and transmits the updated virtual traffic power value via the reverse link immediately before the traffic channel is switched ON. In the second embodiment, a power control method for the traffic-OFF antenna is the same as in the first embodiment except that a virtual traffic power value is transmitted immediately before the traffic channel is switched ON, instead of transmitting the power control bit at every power control group. Here, only one power control bit is required for the traffic-ON antenna.

C. Third Embodiment

With reference to FIGs. 14 and 15, there is illustrated a virtual power control procedure in a mobile station and base station, respectively, according to a third embodiment of the present invention.

Referring to FIG. 14, during traffic-OFF, a mobile station stores the last measured actual traffic power value as the virtual traffic power and the pilot power measured at the previous power control group as the last pilot power lpp1, at step 1412. Thereafter, the mobile station determines whether the traffic channel is ready to be switched ON (i.e., a traffic-ON ready state; Step 1414). Upon failure to detect

the traffic-ON ready state, the mobile station maintains the virtual traffic power and the last pilot power determined in step 1412. However, upon detection of the traffic-ON ready state, the mobile station measures interference power and power of a pilot signal received from a traffic-OFF antenna, and sets the pilot power from the traffic-OFF antenna as a current pilot power pp1, (virtual traffic power)+(pilot power pp1)-(last pilot power lpp1) as the virtual traffic power, and (traffic power)-(interference power) as a virtual SIR, at step 1416.

Thereafter, the mobile station determines a step1 value by subtracting a first threshold Th1 from the virtual SIR, at step 1418, and sends the step1 value to the base station, at step 1420. After sending the step1 value, the mobile station ends the routine.

Referring to FIG. 15, in the traffic-OFF state, the base station sets a last actual traffic gain as a gain value, gain1, of the traffic-OFF antenna, at step 1511. Thereafter, the base station determines whether the traffic channel is ready to be switched ON, at step 1513. When the traffic-OFF state is maintained, the mobile station maintains the gain value determined in step 1511. However, upon detection of the traffic-ON ready state, the base station receives the step1 value transmitted from the mobile station, at step 1515, and updates the gain value, gain1, by adding the step1 value to the gain1 value determined in step 1511 to control the gain of the antenna in the traffic-ON ready state, at step 1517. Thereafter, the base station determines whether the traffic channel is switched ON, at step 1519. Upon detection of the traffic-ON state, the base station ends the routine and starts transmitting signal to the mobile station via the traffic channel.

As described above, the virtual power control method according to the third

embodiment of FIGs. 14 and 15, does not transmit a power control bit for the traffic-OFF channel, and transmits a power value (Step 1), which is calculated from a measured pilot power and interference power, via the reverse link immediately before the traffic channel is switched ON. That is, a power control value can be calculated as follows: from the pilot power and the interference power immediately before the traffic channel is switched OFF, and a difference value between pilot power and interference power immediately before the traffic channel is switched ON.

power control value = (SIR immediately before traffic-OFF) + ((pilot power immediately before traffic-ON) - (pilot power immediately before traffic-OFF)) - ((interference power immediately before traffic-ON) - (interference power immediately before traffic-OFF)) - Th1

The mobile station sends the calculated power control value to the base station via the reverse link immediately before the traffic channel is switched ON. Here, only one power control bit is required for the traffic-ON antenna. In addition, it is not necessary for the mobile station to perform pilot power measurement and virtual power calculation at every power control group.

The above virtual power control method guarantees a reliable operation unless the channel has a transmission error. However, when the channel has transmission errors, the virtual power value deviates from the actual power value, raising a "random walk" problem. To solve this problem, the following methods can be used.

(1) When the reverse channel has a low quality (i.e., when the reverse SIR is low), an accumulated power control command value is not applied.

(2) The upper limit for the accumulated power control command value is restricted.

(3) The antennas are periodically switched.

In the case where the novel virtual power control method is applied to a handoff, two different base stations and a base station controller (BSC) correspond to the two different antennas and the switch of the same base station supporting the transmission diversity, respectively.

Further, in the case where the novel virtual power control method is applied to a mobile communication system supporting the discontinuous transmission mode, there is only one antenna and the traffic channel is switched ON/OFF over the antenna.

A communication system is described in which a traffic channel is switched ON/OFF. The method can effectively control the transmission power, minimizing interference from other users. In particular, the method makes it is possible to control the transmission power even while the traffic channel is switched OFF. That is, when the novel power control method is applied to a channel transmitter supporting the discontinuous transmission mode, a base station sends actual data for a data transmission duration and a specific channel signal (e.g., pilot channel signal) for a data non-transmission duration. Further, a mobile station enables the second PCB generator for the data transmission duration and enables the first PCB generator for the data non-transmission duration.

While the invention has been shown and described with reference to a certain preferred embodiment thereof, it will be understood by those skilled in the art that

various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

WHAT IS CLAIMED IS:

1. A transmission device for a code division multiple access (CDMA) base station including at least two antennas and a switch for switching a spread traffic signal to one of the antennas, comprising:

an adder connected between the switch and a traffic-OFF antenna which does not transmit the spread traffic signal, for transmitting a common channel signal via the traffic-OFF antenna.

2. The transmission device as claimed in claim 1, further comprising a switch controller for connecting the switch to an antenna having better channel environment according to the analysis of received message transmitted from a mobile station .

3. The transmission device as claimed in claim 1, further comprising a switch controller for controlling the switch to switch the traffic signal to the antennas according to a transmission antenna period pattern.

4. The transmission device as claimed in claim 2 or 3, wherein a switching period of the switch controller is longer than or equal to a power control group duration.

5. The transmission device as claimed in claim 1, further comprising:

a power control bit extractor for extracting a power control bit transmitted from a mobile station; and

a gain controller for controlling transmission power of respective transmission signals output from the antennas according to the extracted power

control bit.

6. The transmission device as claimed in claim 1, wherein the common channel is a pilot channel.

7. A channel transmission device for a base station in a CDMA communication system, comprising:

a data channel generator for spreading data in a discontinuous transmission mode and transmitting the spread data;

a common channel generator for generating a common channel signal; and

a switch for selectively outputting an output of the common channel generator instead of the spread data signal, when there is no spread signal output from the data channel generator.

8. The channel transmission device as claimed in claim 7, where a switching period of the switch is longer than or equal to a power control group duration.

9. The channel transmission device as claimed in claim 8, further comprising:

a power control bit extractor for extracting a power control bit transmitted from a mobile station; and

a gain controller for controlling transmission power of transmission data according to the extracted power control bit.

10. A power control device for a mobile station in a CDMA communication system including a base station which transmits a traffic signal via

one of at least two antennas and transmits a common channel signal via another antenna, the device comprising:

a receiver for receiving the transmitted traffic and common channel signals via one antenna;

an interference power measurer for measuring power of an interference signal output from the receiver;

a common channel power measurer for measuring power of the common channel signal output from the receiver;

a traffic channel power measurer for measuring power of the traffic signal output from the receiver;

a power control bit generator for generating a power control bit for a traffic-OFF channel which has transmitted the common channel signal by operating the power of the common channel signal and interference signal; and

a multiplexer for multiplexing the power control bits to a reverse link channel.

11. The power control device as claimed in claim 10, wherein the power control bit generator comprises:

a first power control bit generator for generating a first power control bit for the traffic-OFF channel which has transmitted the common channel signal, by operating power of the common channel signal and the power of the interference signal; and

a second power control bit generator for generating a second power control bit for a traffic-ON channel which has transmitted the traffic signal, by operating power of the traffic signal and power of the interference signal.

12. The power control device as claimed in claim 11, wherein the first

power control bit generator comprises:

a signal-to-interference ratio (SIR) measurer for measuring, during traffic-OFF, power of a common channel signal from a traffic-OFF antenna in a power control group unit to calculate a virtual SIR; and

a comparator for comparing the virtual SIR with a threshold to determine a value of the power control bit according to the comparison;

wherein the virtual SIR is defined as

virtual SIR = (virtual traffic power) - (interference power)

(virtual traffic power) = (virtual traffic power) + (power control command value) + ((present common channel power) - (previous common channel power))

where the virtual traffic power is a last actual traffic power, and the previous common channel power is power of the common channel, measured by the common channel power measurer in a previous state.

13. The power control device as claimed in claim 12, wherein the common channel signal is a pilot channel signal.

14. A transmission diversity method for a CDMA base station including at least two antennas and a switch for switching a spread traffic signal to one of the antennas, comprising the steps of:

transmitting the spread traffic signal via an antenna; and

transmitting a common channel signal via another antenna.

15. The transmission diversity method as claimed in claim 14, further comprising a step of analyzing received message transmitted from a mobile station

and connecting the switch to an antenna having better channel environment according to the analysis.

16. The transmission diversity method as claimed in claim 14, wherein the switch switches the traffic signal to the antennas according to a periodic pattern.

17. The transmission diversity method as claimed in claim 15 or 16, wherein a switching period of the switch is longer than or equal to a power control group duration.

18. The transmission diversity method as claimed in claim 14, wherein the common channel is a pilot channel.

19. A power control method at a mobile station in a CDMA communication system including a base station which transmits a traffic signal via one of at least two antennas and transmits a common channel signal via another antenna, the method comprising the steps of:

receiving the traffic and common channel signals transmitted from the base station;

measuring power of an interference signal, the common channel signal and the traffic channel signal received from the base station;

generating a power control bit for a traffic-OFF channel which has transmitted the common channel signal, by operating power of the common channel signal and interference signals; and

multiplexing the power control bit to a reverse link channel.

20. The power control method as claimed in claim 19, wherein the power

control bit generating step comprises the steps of:

generating a first power control bit for the traffic-OFF channel which has transmitted the common channel signal, by operating power of the common channel signal and power of the interference signal; and

generating a second power control bit for a traffic-ON channel which has transmitted the traffic signal, by operating power of the traffic signal and power of the interference signal.

21. The power control method as claimed in claim 20, wherein the first power control bit generating step comprises the steps of:

measuring, during traffic-OFF, power of a common channel signal from a traffic-OFF antenna in a power control group unit to calculate a virtual SIR; and

comparing the virtual SIR with a threshold to determine a value of the power control bit according to the comparison;

wherein the virtual SIR is defined as

virtual SIR = (virtual traffic power) - (interference power)

(virtual traffic power) = (virtual traffic power) + (power control command value) + ((present common channel power) - (previous common channel power))

where the virtual traffic power is a last actual traffic power, and the previous common channel power is power of the common channel, measured by the common channel power measurer in a previous state.

22. The power control method as claimed in claim 21, wherein the common channel signal is a pilot channel signal.

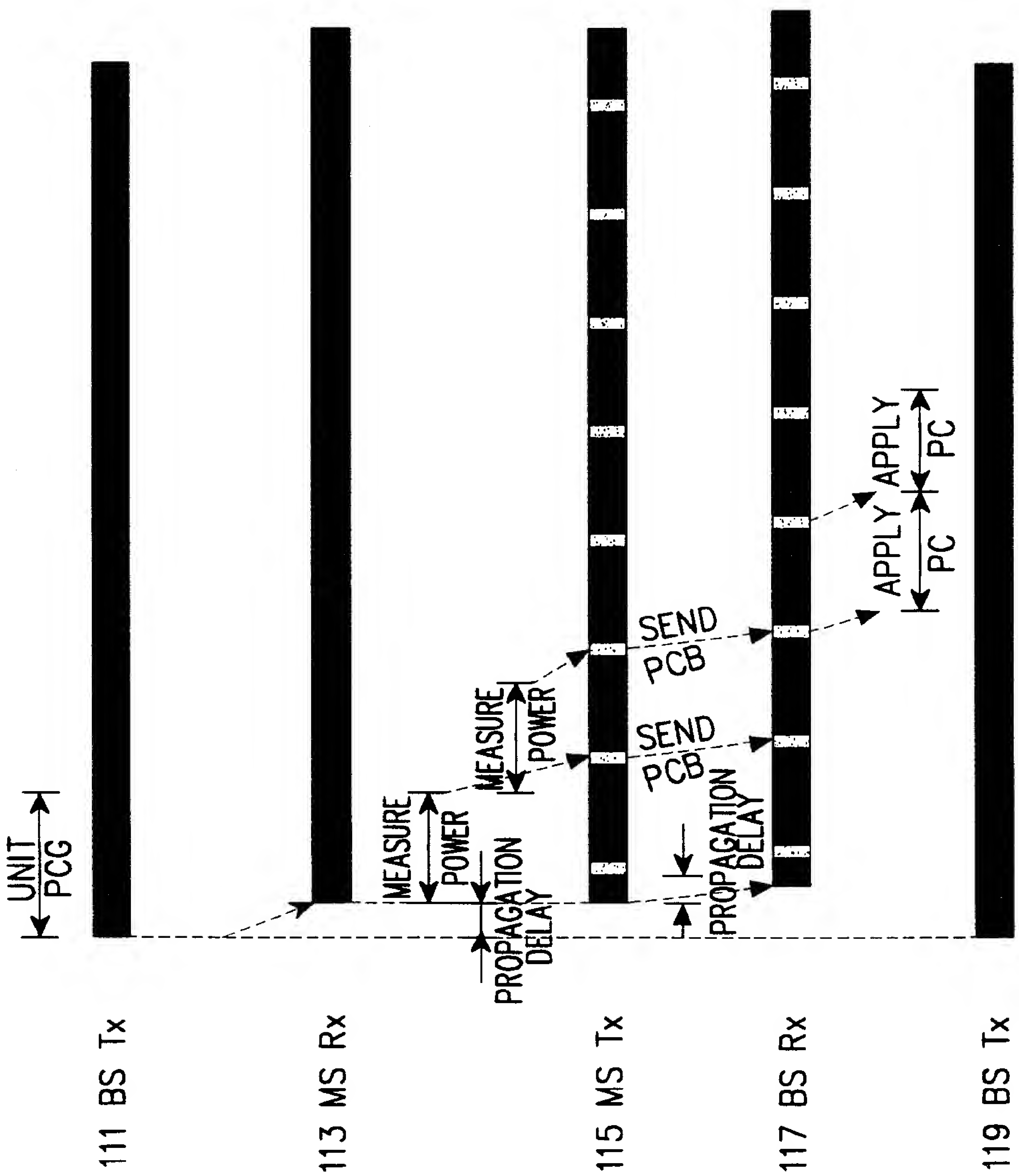

111 BS Tx
113 MS Rx
115 MS Tx
117 BS Rx
119 BS Tx
UNIT PCG
MEASURE POWER
PROPAGATION DELAY
SEND PCB
APPLY PC

FIG. 1

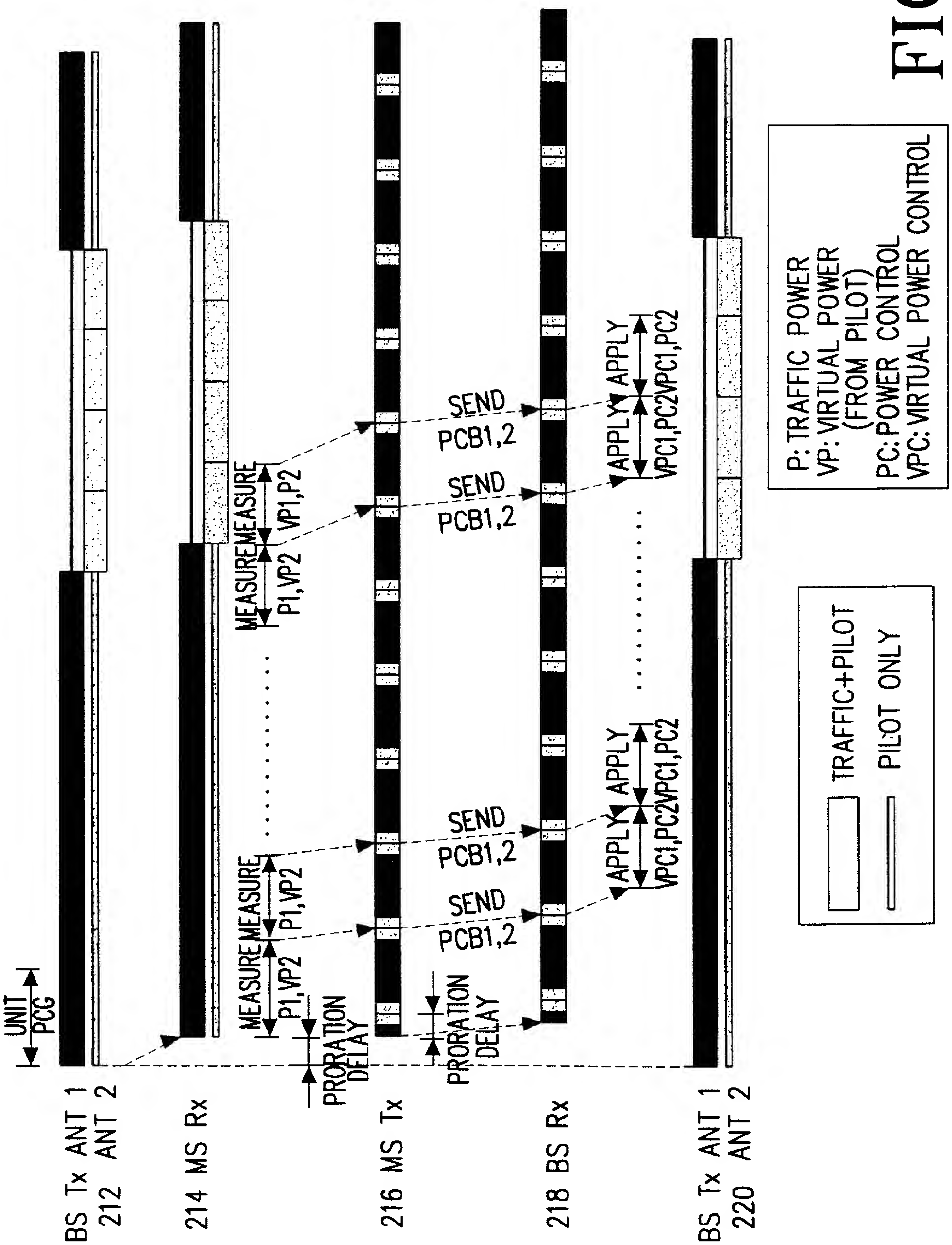

UNIT PCG
BS Tx ANT 1
212 ANT 2
214 MS Rx
216 MS Tx
218 BS Rx
BS Tx ANT 1
220 ANT 2
PRORATION DELAY
PRORATION DELAY
MEASURE
P1,VP2
MEASURE
P1,VP2
MEASURE
P1,VP2
MEASURE
VP1,P2
SEND
PCB1,2
SEND
PCB1,2
SEND
PCB1,2
SEND
PCB1,2
APPLY
VPC1,PC2
APPLY
VPC1,PC2
APPLY
VPC1,PC2
APPLY
VPC1,PC2
P: TRAFFIC POWER
VP: VIRTUAL POWER
(FROM PILOT)
PC: POWER CONTROL
VPC: VIRTUAL POWER CONTROL
TRAFFIC+PILOT
PILOT ONLY

FIG. 2

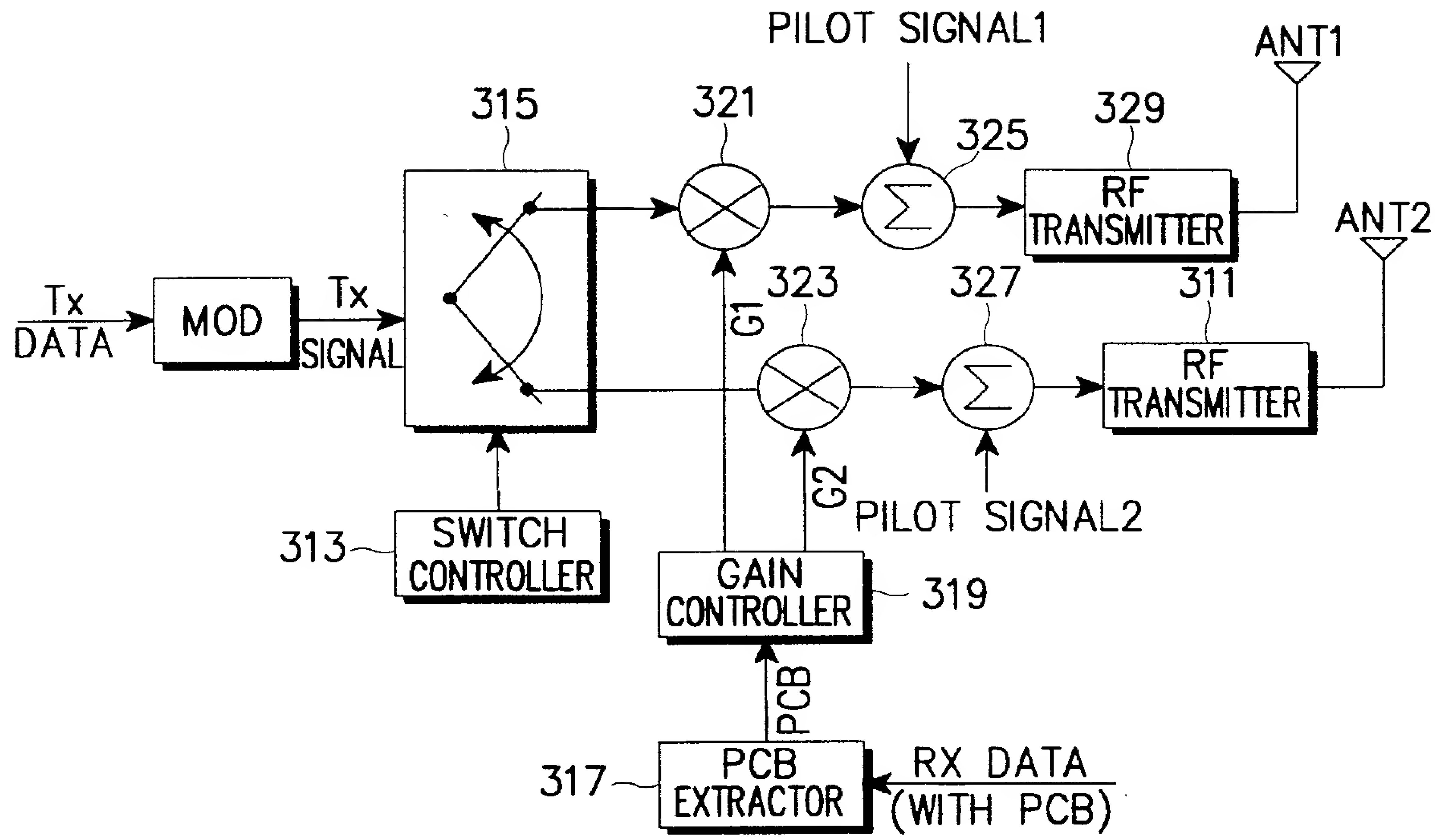

PILOT SIGNAL1
ANT1
315
321
325
329
RF TRANSMITTER
ANT2
Tx DATA
MOD
Tx SIGNAL
323
327
311
G1
RF TRANSMITTER
G2
PILOT SIGNAL2
313
SWITCH CONTROLLER
GAIN CONTROLLER
319
PCB
317
PCB EXTRACTOR
RX DATA (WITH PCB)

FIG. 3

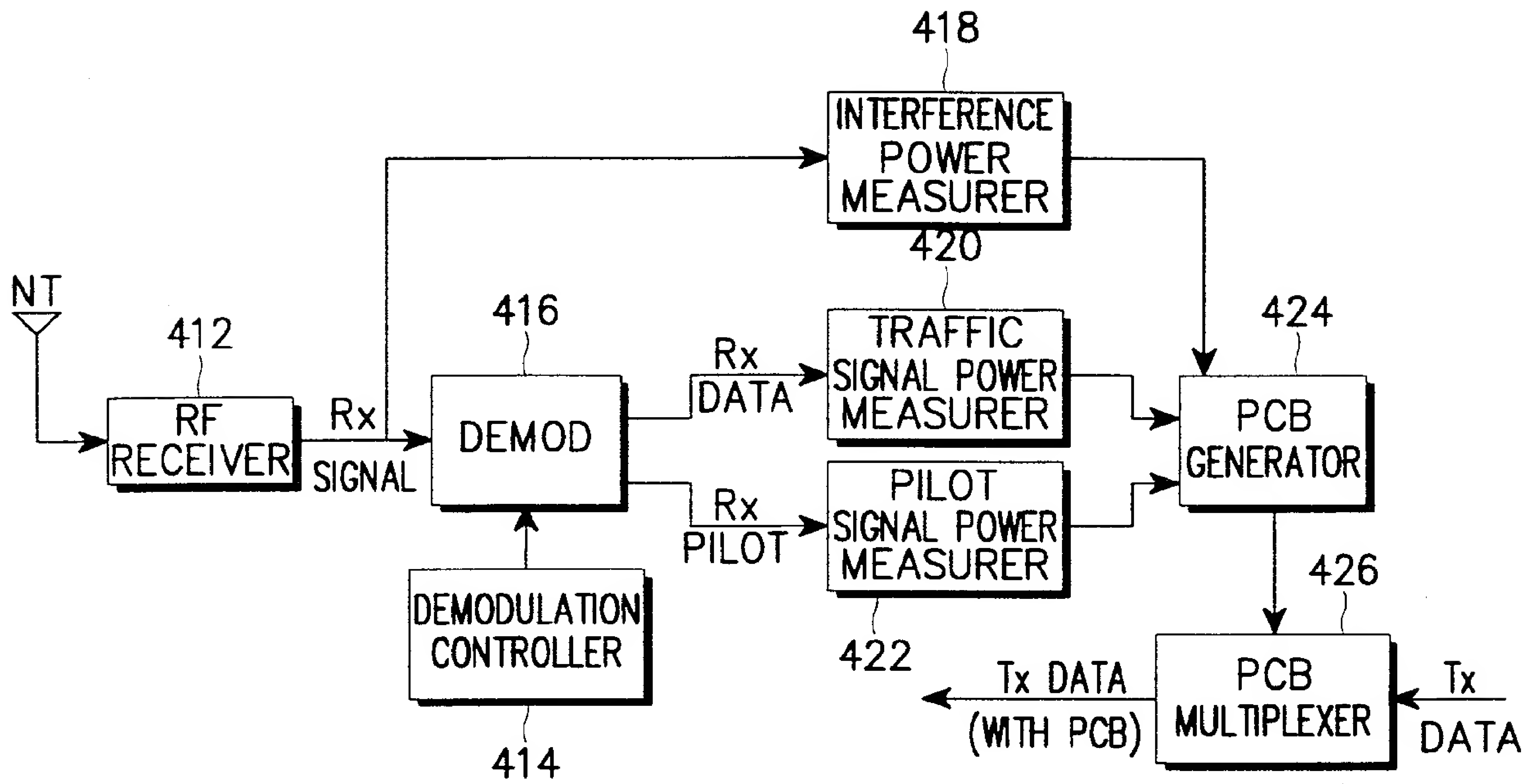

418
INTERFERENCE POWER MEASURER
420
NT
412
416
TRAFFIC SIGNAL POWER MEASURER
424
Rx DATA
RF RECEIVER
Rx SIGNAL
DEMOD
PCB GENERATOR
PILOT SIGNAL POWER MEASURER
Rx PILOT
426
DEMODULATION CONTROLLER
422
Tx DATA (WITH PCB)
PCB MULTIPLEXER
Tx DATA
414

FIG. 4

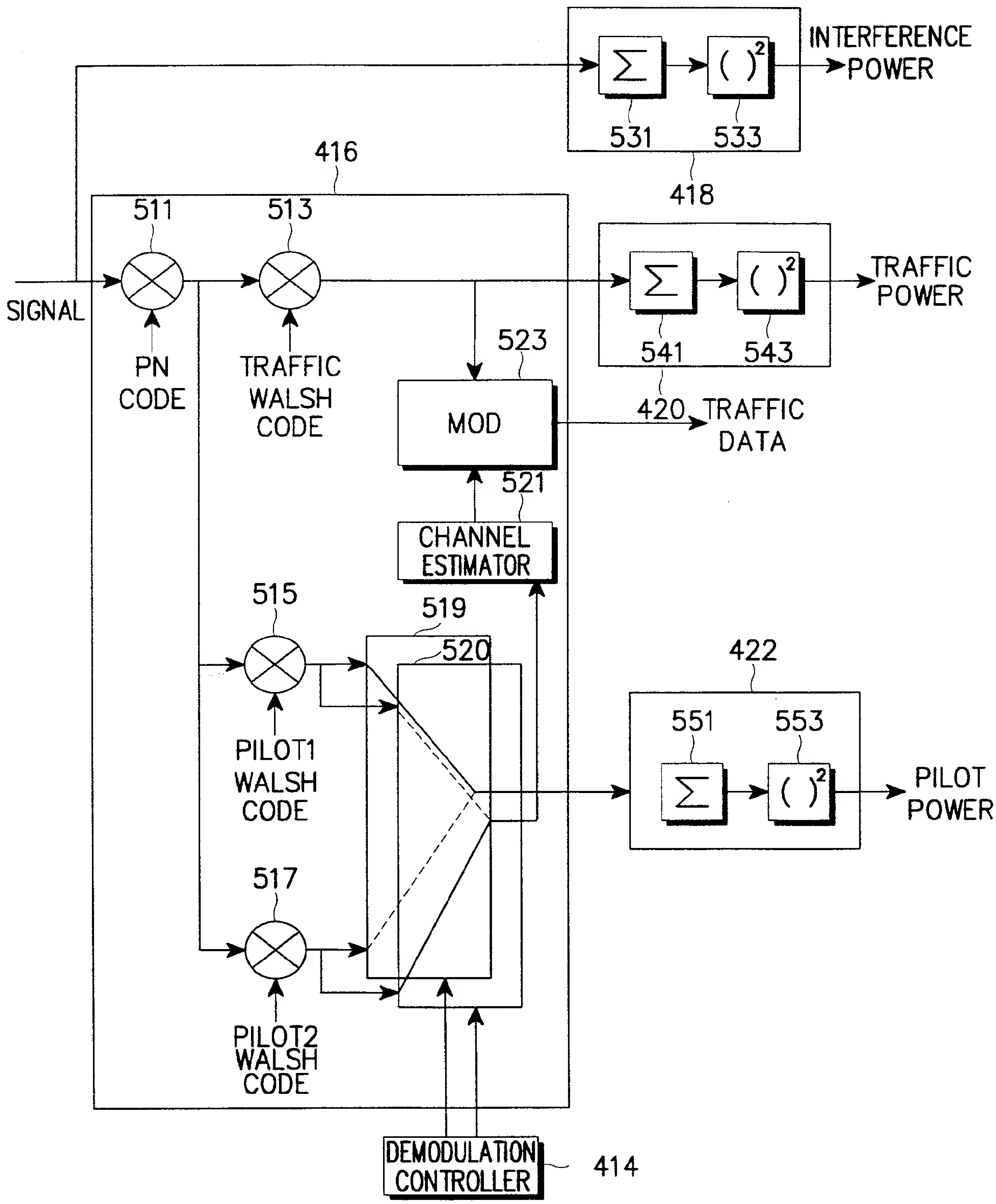
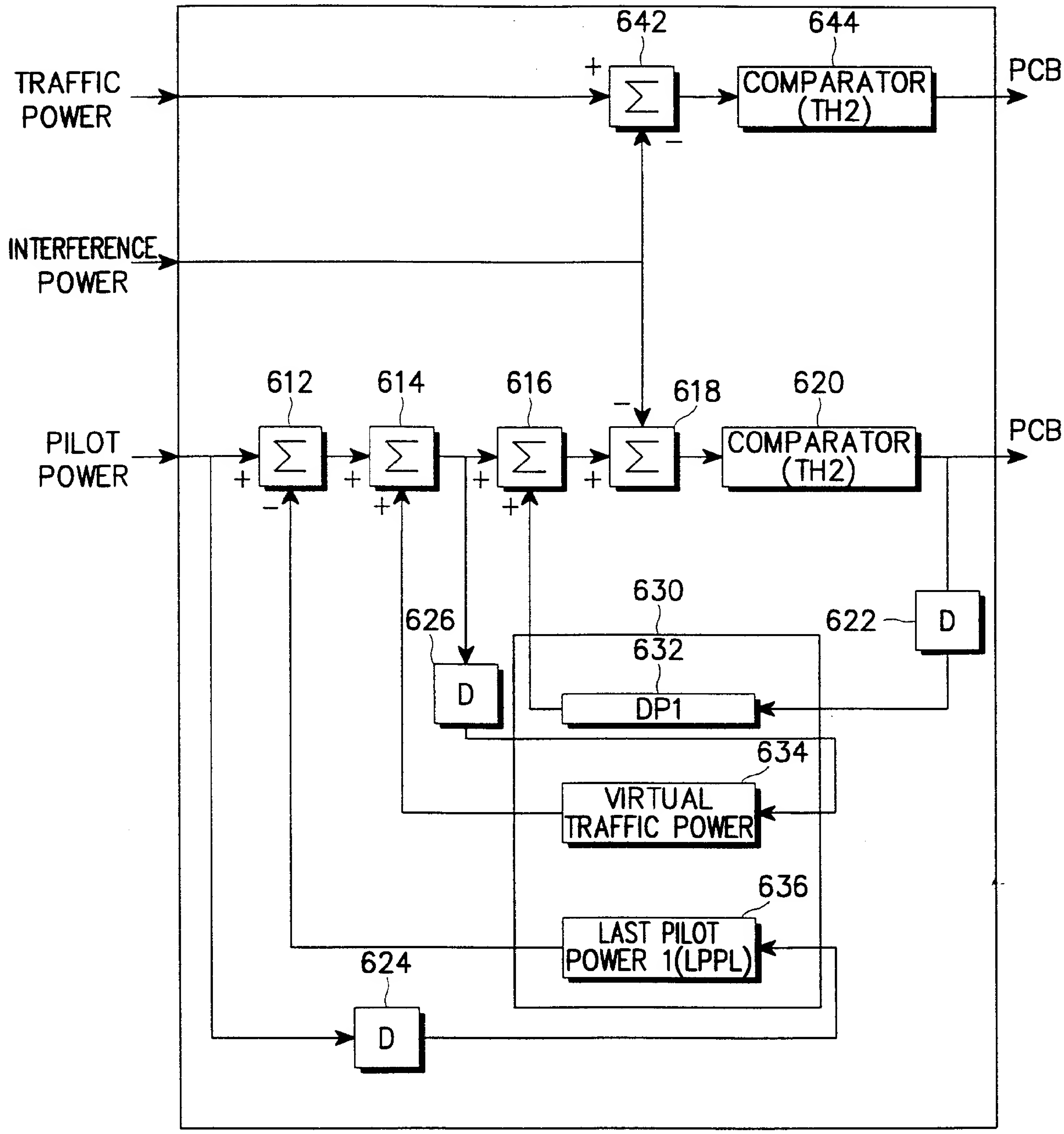

INTERFERENCE POWER
531
533
416
418
511
513
SIGNAL
PN CODE
TRAFFIC WALSH CODE
TRAFFIC POWER
541
543
523
MOD
420
TRAFFIC DATA
521
CHANNEL ESTIMATOR
515
519
520
422
551
553
PILOT1 WALSH CODE
PILOT POWER
517
PILOT2 WALSH CODE
DEMODULATION CONTROLLER
414

FIG. 5



TRAFFIC POWER
INTERFERENCE POWER
PILOT POWER
642
644
COMPARATOR (TH2)
PCB
612
614
616
618
620
COMPARATOR (TH2)
PCB
630
622
D
626
632
D
DP1
634
VIRTUAL TRAFFIC POWER
636
LAST PILOT POWER 1(LPPL)
624
D

FIG. 6

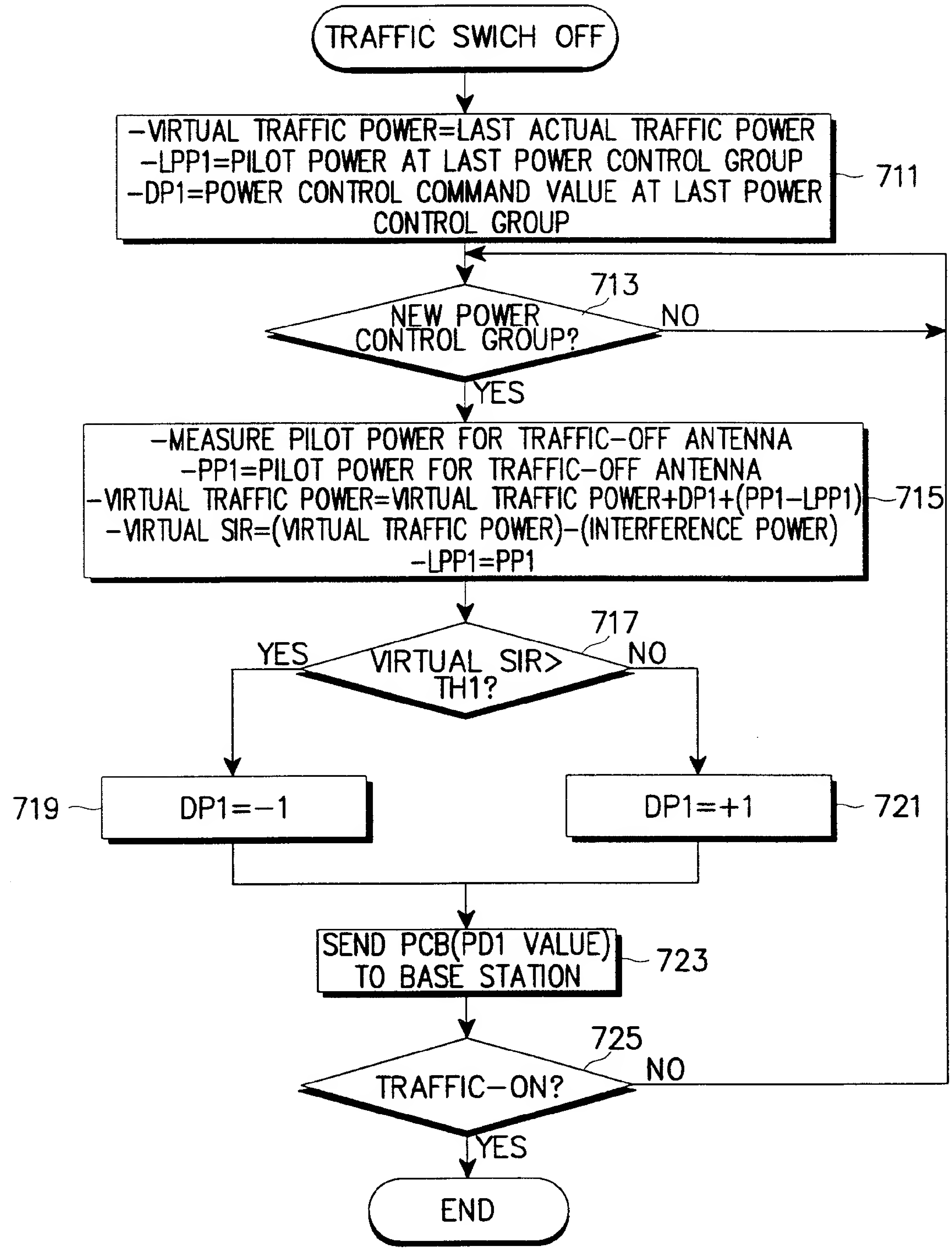

TRAFFIC SWICH OFF
-VIRTUAL TRAFFIC POWER=LAST ACTUAL TRAFFIC POWER
-LPP1=PILOT POWER AT LAST POWER CONTROL GROUP
-DP1=POWER CONTROL COMMAND VALUE AT LAST POWER CONTROL GROUP
711
713
NEW POWER CONTROL GROUP?
NO
YES
-MEASURE PILOT POWER FOR TRAFFIC-OFF ANTENNA
-PP1=PILOT POWER FOR TRAFFIC-OFF ANTENNA
-VIRTUAL TRAFFIC POWER=VIRTUAL TRAFFIC POWER+DP1+(PP1-LPP1)
-VIRTUAL SIR=(VIRTUAL TRAFFIC POWER)-(INTERFERENCE POWER)
-LPP1=PP1
715
717
YES
VIRTUAL SIR> TH1?
NO
719
DP1=-1
DP1=+1
721
SEND PCB(PD1 VALUE) TO BASE STATION
723
725
TRAFFIC-ON?
NO
YES
END

FIG. 7

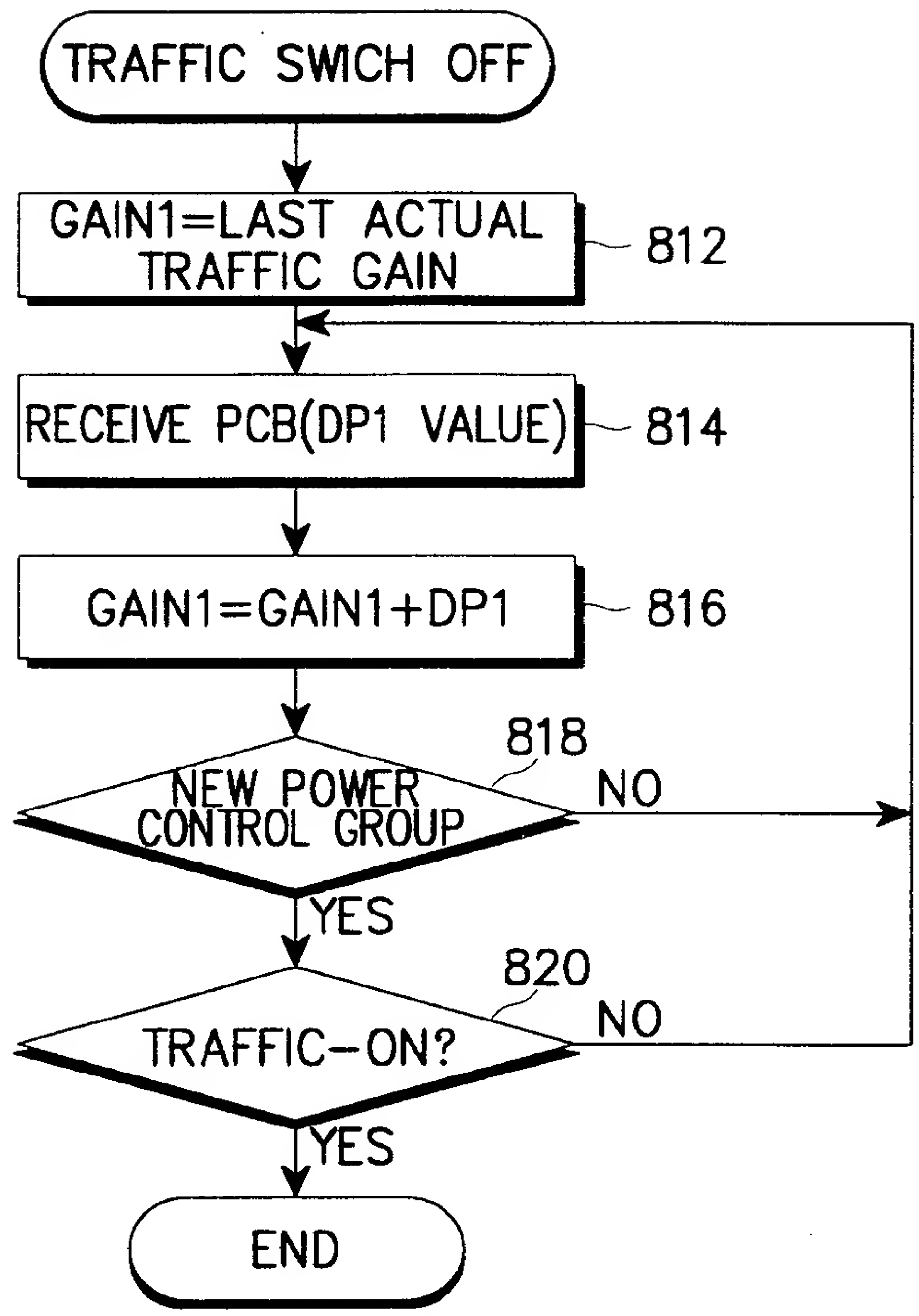

TRAFFIC SWICH OFF
GAIN1=LAST ACTUAL TRAFFIC GAIN
812
RECEIVE PCB(DP1 VALUE)
814
GAIN1=GAIN1+DP1
816
818
NEW POWER CONTROL GROUP
NO
YES
820
TRAFFIC-ON?
NO
YES
END

FIG. 8

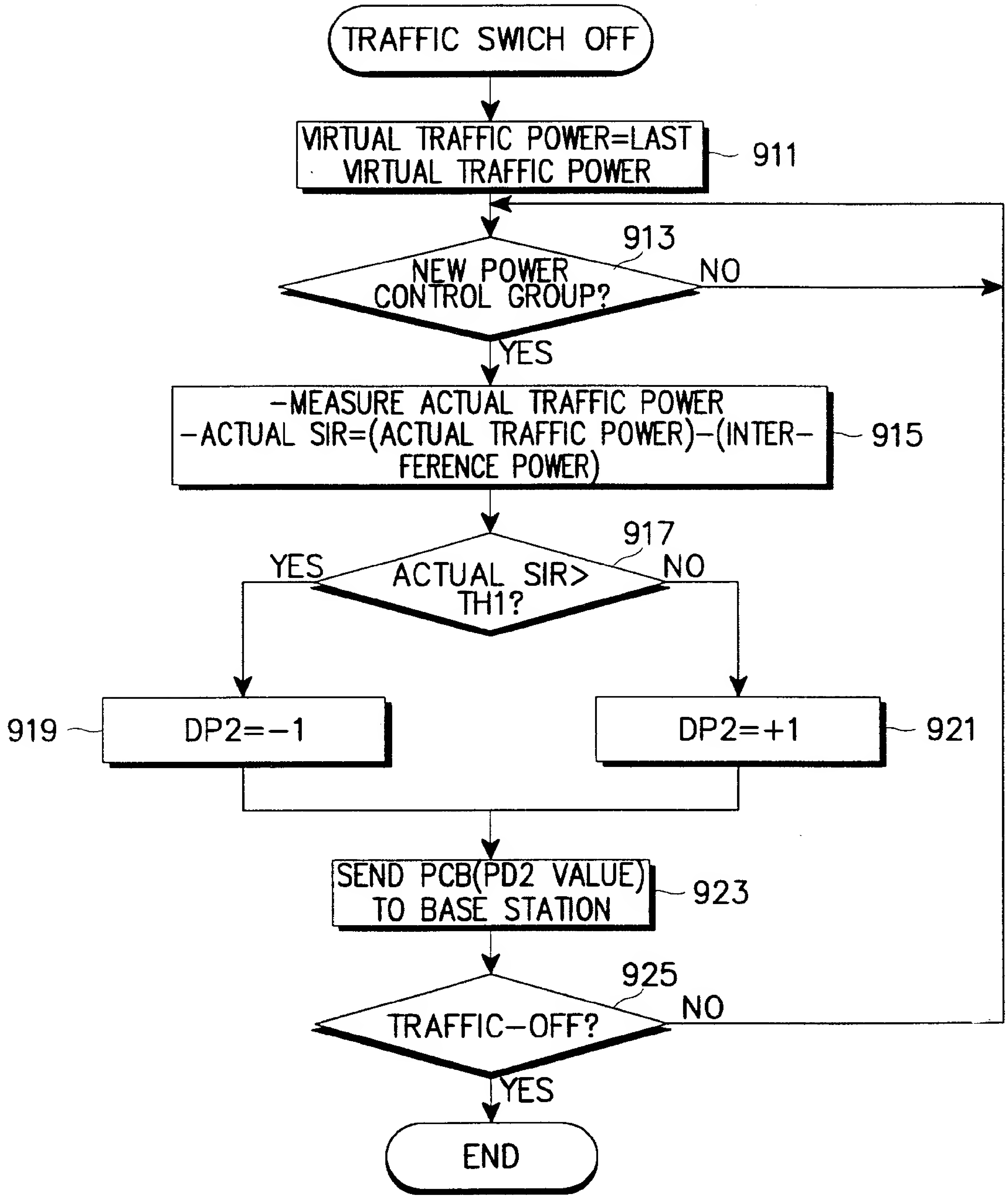

TRAFFIC SWICH OFF
VIRTUAL TRAFFIC POWER=LAST VIRTUAL TRAFFIC POWER
911
913
NEW POWER CONTROL GROUP?
NO
YES
-MEASURE ACTUAL TRAFFIC POWER
-ACTUAL SIR=(ACTUAL TRAFFIC POWER)-(INTERFERENCE POWER)
915
917
ACTUAL SIR> TH1?
YES
NO
919
DP2=-1
DP2=+1
921
SEND PCB(PD2 VALUE) TO BASE STATION
923
925
TRAFFIC-OFF?
NO
YES
END

FIG. 9

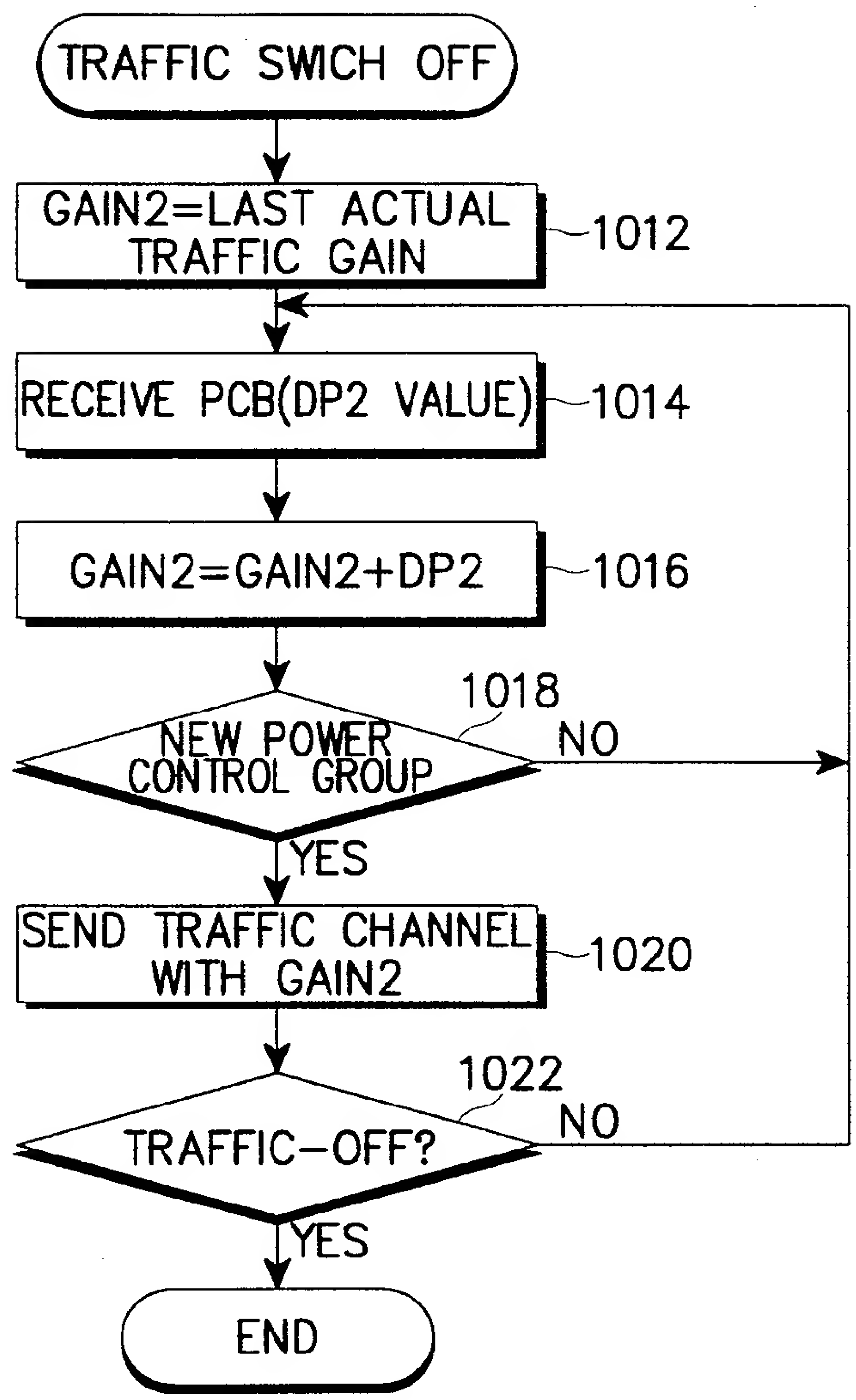

TRAFFIC SWICH OFF
GAIN2=LAST ACTUAL TRAFFIC GAIN
1012
RECEIVE PCB(DP2 VALUE)
1014
GAIN2=GAIN2+DP2
1016
1018
NEW POWER CONTROL GROUP
NO
YES
SEND TRAFFIC CHANNEL WITH GAIN2
1020
1022
TRAFFIC-OFF?
NO
YES
END

FIG. 10

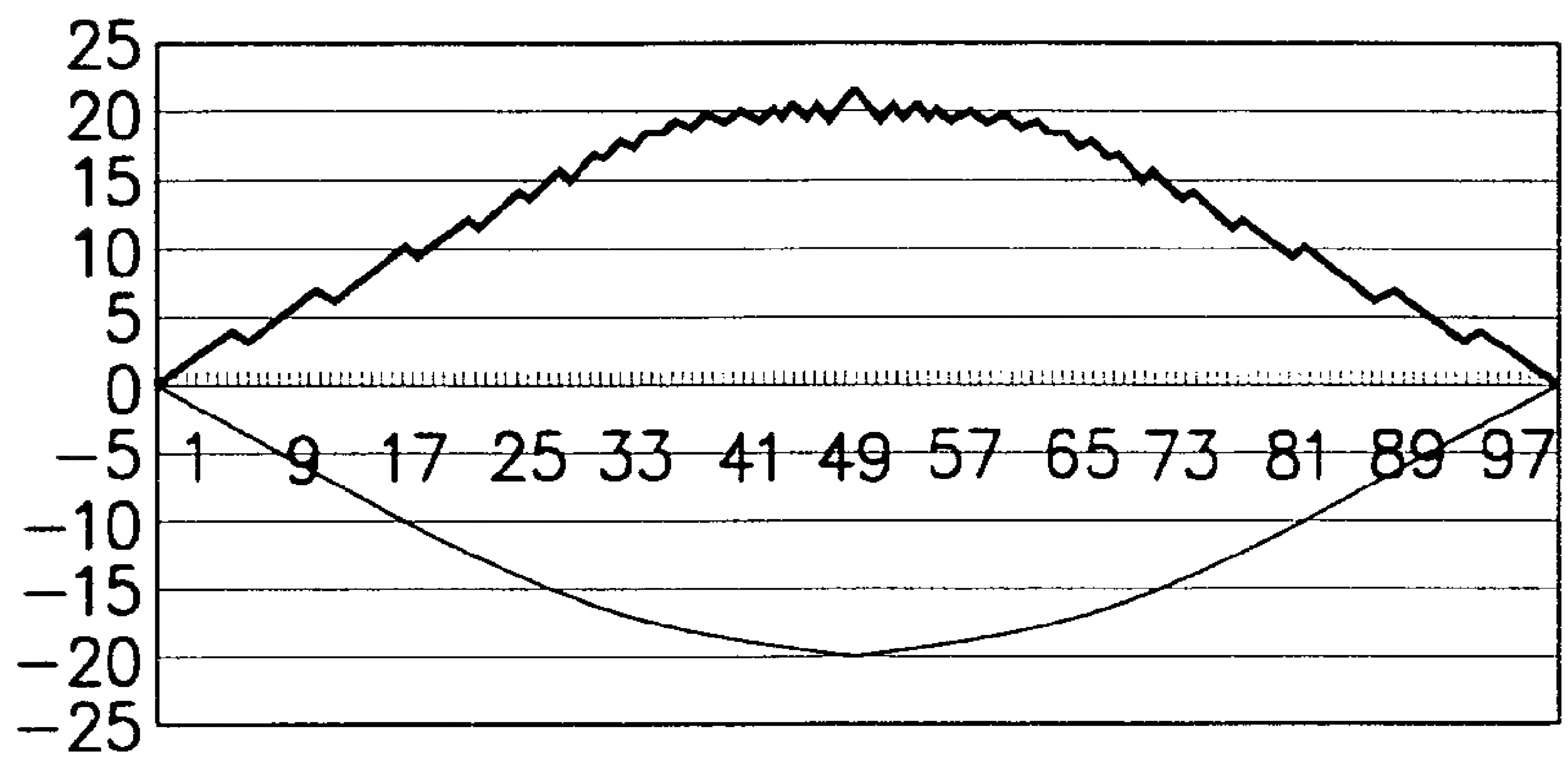


FIG. 11

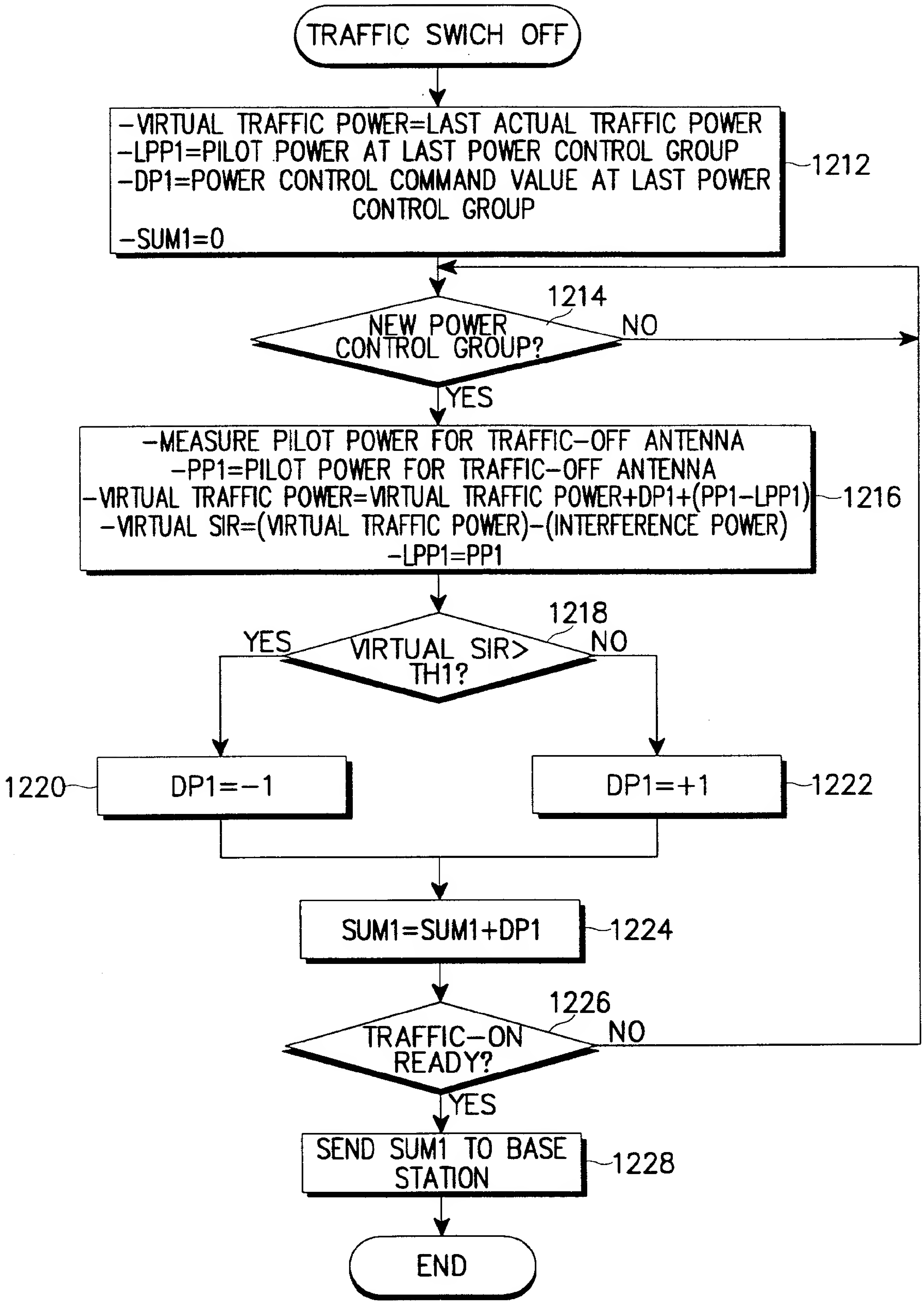

TRAFFIC SWICH OFF
-VIRTUAL TRAFFIC POWER=LAST ACTUAL TRAFFIC POWER
-LPP1=PILOT POWER AT LAST POWER CONTROL GROUP
-DP1=POWER CONTROL COMMAND VALUE AT LAST POWER CONTROL GROUP
-SUM1=0
1212
NEW POWER CONTROL GROUP?
1214
NO
YES
-MEASURE PILOT POWER FOR TRAFFIC-OFF ANTENNA
-PP1=PILOT POWER FOR TRAFFIC-OFF ANTENNA
-VIRTUAL TRAFFIC POWER=VIRTUAL TRAFFIC POWER+DP1+(PP1-LPP1)
-VIRTUAL SIR=(VIRTUAL TRAFFIC POWER)-(INTERFERENCE POWER)
-LPP1=PP1
1216
VIRTUAL SIR> TH1?
1218
YES
NO
1220
DP1=-1
DP1=+1
1222
SUM1=SUM1+DP1
1224
TRAFFIC-ON READY?
1226
NO
YES
SEND SUM1 TO BASE STATION
1228
END

FIG. 12

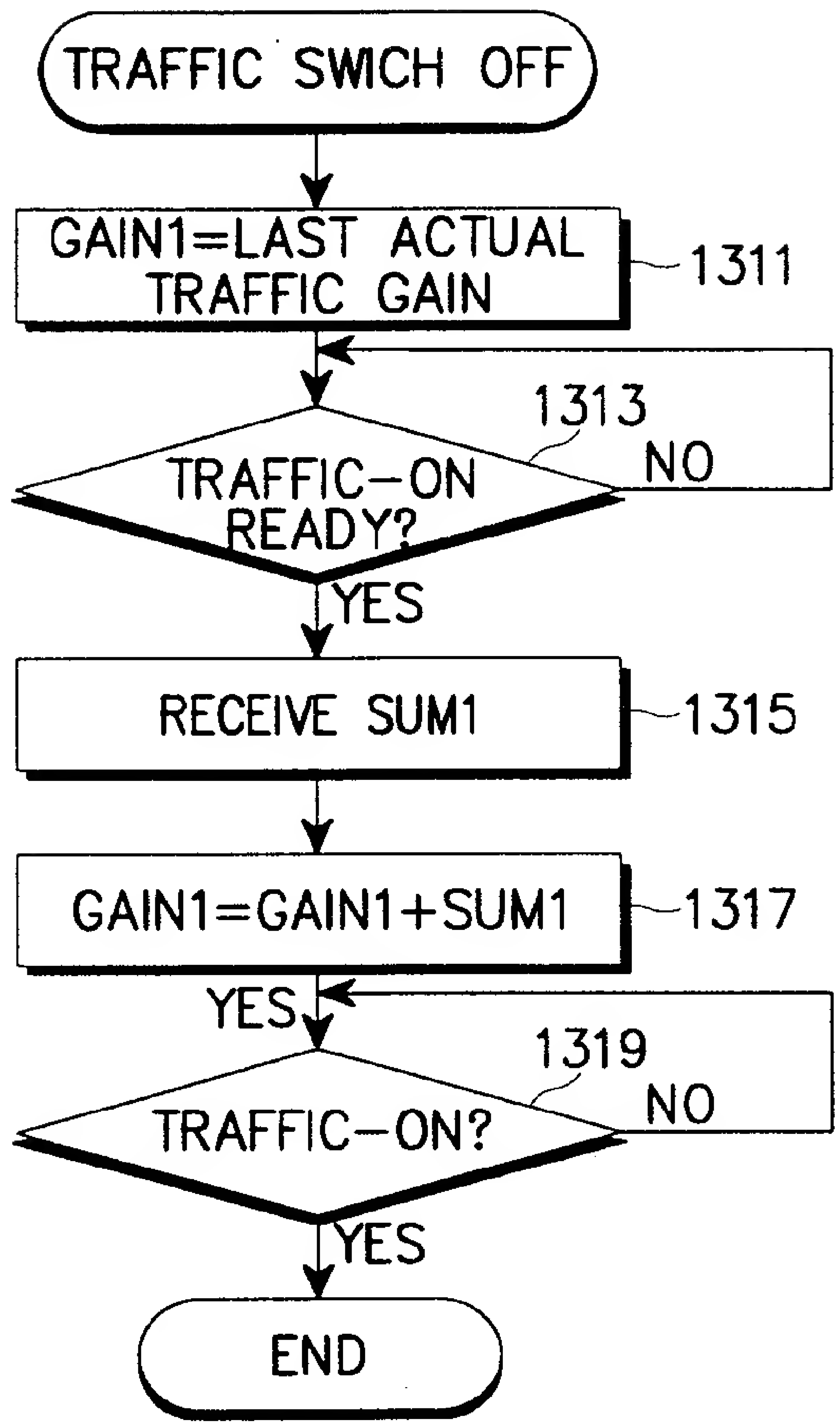

TRAFFIC SWICH OFF
GAIN1=LAST ACTUAL TRAFFIC GAIN
1311
1313
NO
TRAFFIC-ON READY?
YES
RECEIVE SUM1
1315
GAIN1=GAIN1+SUM1
1317
YES
1319
NO
TRAFFIC-ON?
YES
END

FIG. 13

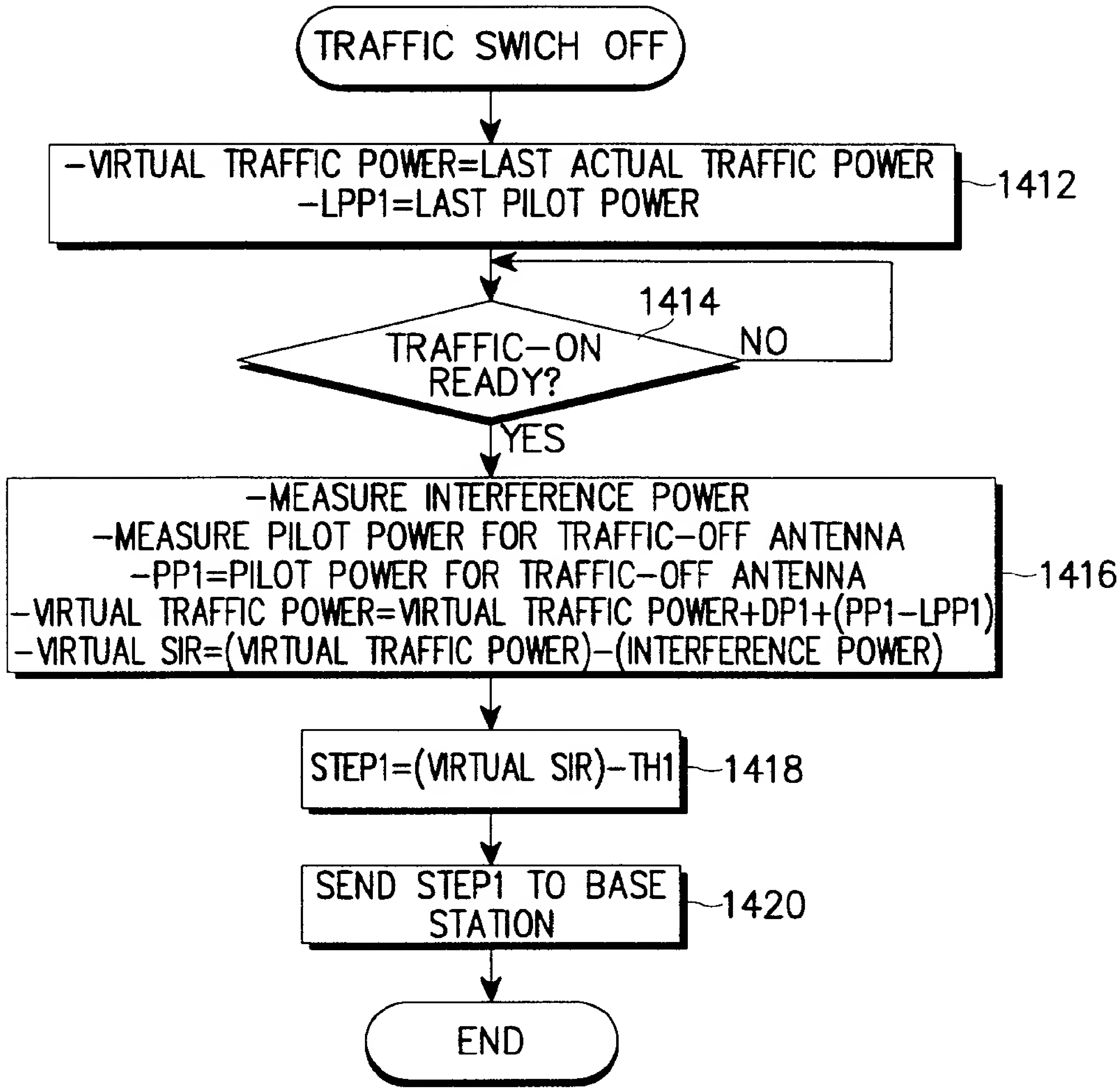

TRAFFIC SWICH OFF
-VIRTUAL TRAFFIC POWER=LAST ACTUAL TRAFFIC POWER
-LPP1=LAST PILOT POWER
1412
1414
TRAFFIC-ON READY?
NO
YES
-MEASURE INTERFERENCE POWER
-MEASURE PILOT POWER FOR TRAFFIC-OFF ANTENNA
-PP1=PILOT POWER FOR TRAFFIC-OFF ANTENNA
-VIRTUAL TRAFFIC POWER=VIRTUAL TRAFFIC POWER+DP1+(PP1-LPP1)
-VIRTUAL SIR=(VIRTUAL TRAFFIC POWER)-(INTERFERENCE POWER)
1416
STEP1=(VIRTUAL SIR)-TH1
1418
SEND STEP1 TO BASE STATION
1420
END

FIG. 14

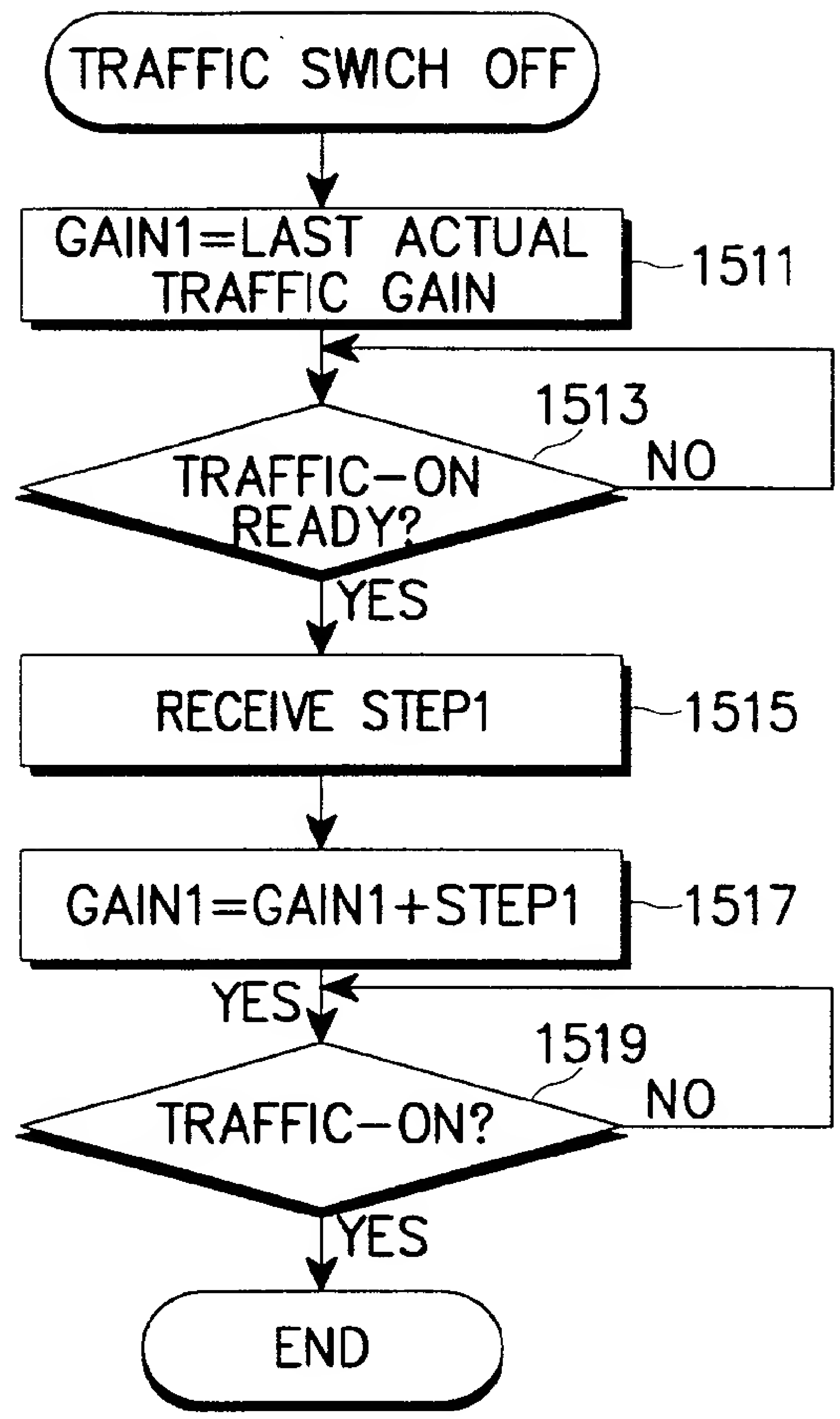

TRAFFIC SWICH OFF
GAIN1=LAST ACTUAL TRAFFIC GAIN
1511
1513
TRAFFIC-ON READY?
NO
YES
RECEIVE STEP1
1515
GAIN1=GAIN1+STEP1
1517
YES
1519
TRAFFIC-ON?
NO
YES
END

FIG. 15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 99/00298

A. CLASSIFICATION OF SUBJECT MATTER

IPC[6]: H 04 Q 7/20 H 04 B 7/005

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC[6]: H 04 Q 7/00 7/20, H 04 B 7/00 7/005

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 737 327 A (F. LING et al.) 07 April 1998 (07.04.98), totality.	1 - 22
A	US 5 570 353 A (I. KEKSI TALO et al.) 29 October 1996 (29.10.96), totality.	1 - 22

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
„A“ document defining the general state of the art which is not considered to be of particular relevance
„E“ earlier application or patent but published on or after the international filing date
„L“ document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
„O“ document referring to an oral disclosure, use, exhibition or other means
„P“ document published prior to the international filing date but later than the priority date claimed

„T“ later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
„X“ document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
„Y“ document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
„&“ document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 September 1999 (28.09.99)	08 November 1999 (08.11.99)
Name and mailing adress of the ISA/AT Austrian Patent Office Kohlmarkt 8-10; A-1014 Vienna Facsimile No. 1/53424/200	Authorized officer Zugarek Telephone No. 1/53424/383

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR 99/00298

Im Recherchenbericht angeführtes Patentdokument Patent document cited in search report Document de brevet cité dans le rapport de recherche	Datum der Veröffentlichung Publication date Date de publication	Mitglied(er) der Patentfamilie Patent family member(s) Membre(s) de la famille de brevets	Datum der Veröffentlichung Publication date Date de publication
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